DEVELOPMENT AND VALIDATION OF A GENERAL NUTRITION KNOWLEDGE QUESTIONNAIRE FOR ADULTS IN UGANDA

BY

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DISSERTATION

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ABSTRACT

KNOWLEDGE is an essential element in several theoretical frameworks aimed at explaining human behavior and nutrition practices among individuals, and in institutions and communities. Head teachers are key change agents in a school environment that most likely would influence any nutrition intervention. Basic nutrition knowledge may enable them to improve school nutrition practices. In general, nutrition knowledge has been poorly evaluated in Uganda and there is no data on nutrition knowledge of school stakeholders such as head teachers and teachers. This dissertation study aimed at developing a general nutrition knowledge questionnaire (GNKQ) to obtain valid and reliable data using psychometric measures from head teachers in elementary schools in Uganda. The first draft of GNKQ comprised of five knowledge dimensions and 133 items evaluating basic nutrition knowledge on *Expert recommendations* (16 items), *Food groups* (70 items), *Selecting food* (10 items), *Relationship of nutrition and disease* (23 items) and *Food fortification* (14 items). The draft GNKQ was reviewed twice by a panel of five experts. Face validation took place in between expert reviews and involved independent reviews and three focal groups with 15 head teachers and 12 health workers from Kampala. Experts finally agreed (Content Validity Index = 0.97, and Gwet's AC1 = 0.96) with revisions that items in the questionnaire were relevant to evaluate general nutrition knowledge of adults in Uganda. In the initial pilot testing of the survey instrument, 40 head teachers from schools in Kampala along with 40 nutrition students and 37 engineering students from Makerere University were recruited. The participants filled the questionnaire twice within two weeks. Results showed that the GNKQ had acceptable internal consistency (Cronbach $\alpha = 0.95$), test-retest reliability ($r = 0.89$), and concurrent validity, in which the nutrition knowledge scores of nutrition and engineering students obtained using the instrument were significantly different (67 ± 5 vs. 39 ± 11; $p < 0.001$). Only the domain on *Expert recommendation* had unreliable data ($\alpha = 0.51$, test-retest, $r = 0.55$). Results from initial pilot were used to review items in the study. The final draft comprised of 137 items to evaluate basic nutrition knowledge on *Expert recommendations* (16), *Food groups* (67), *Selecting food* (10), and *Relationship of nutrition and disease* (22) and one on *Food fortification* (22). The pilot was followed up with a larger sample of head teachers ($n = 255$) who filled out the drafted GNKQ. One hundred and thirty-six head teachers completed their surveys the second week of the retest. The overall *internal consistency* was $\alpha = 0.89$ and 0.92 at time one and two, respectively on

94 items. Results from test-retest reliability indicated that two domains, *Expert recommendations* (Intraclass Correlation Coefficient; ICC = 0.64) and *Selecting food (*ICC =0.41) were not acceptable ($r < 0.7$ and ICC < 0.7), and therefore, their items were removed from the proceeding analyses. The other domains had acceptable test-retest reliability: *Food groups* (ICC = 0.9), *Relationship of nutrition and disease* (ICC = 0.91), and *Food fortification* (ICC = 0.95). To ascertain external validity, the GNKQ was applied to a sample of agricultural extension agents (n = 80) living in the Kiboga and Kyankwanzi districts. The questionnaire (85 items) had adequate internal consistency (Cronbach $\alpha = 0.93$), while 52 items were removed from analyses because they had poor item discrimination ($r < 0.2$). With exception of *Selecting foods,* all other nutrition knowledge domains had adequate internal consistencies (Cronbach $\alpha > 0.7$). The ICC for the whole questionnaire was 0.9. All the remaining nutrition knowledge domains had adequate test-retest reliability (ICC > 0.7). Finally, the Diffusion of Innovation framework was applied in an effort to demonstrate that nutrition knowledge of head teachers would influence adoption (awareness and implementation) of the Guidelines for School Feeding and Nutrition Intervention Program of Uganda (GSFNIP). Results from correlations and multiple linear regression analyses revealed that head teachers' basic nutrition knowledge was related to *awareness* ($r = 0.2$, $p < 0.01$; $\beta = 0.158$, $p = 0.006$), but not to the *degree of implementation* ($r = -0.04$, $p > 0.05$; $\beta = -0.032$, $p = 0.621$) of the GSFNIP. Factors associated with the school environment such as *being a private school, involvement of parents, higher number of qualified teachers,* and *more school materials* predicted a higher degree of implementation of the GSFNIP. These studies show that data collected using the GNKQ has acceptable content, face, concurrent, predictive, and external validity, and reliability. This is the first of its kind general nutrition knowledge questionnaire for adult population in Uganda. This tool can be used to evaluate general nutrition knowledge of head teachers and extension workers. Future studies should continue the validation of this survey instrument in other adult populations.

DEDICATION

This dissertation work is dedicated to my mum, Betty Nattumba.

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CHAPTER 1: OVERVIEW

1.1 Introduction

Malnutrition undermines national education efforts in Uganda. Undernutrition (underweight and stunting) and micronutrient deficiencies such as iron deficiency and anemia are the major forms of malnutrition among school-age (6-12 years) children. Recent surveys have shown that 20% of children in the same age group are underweight (i.e., low weight for age) while 80% and 38% are either iron-deficient and have anemia respectively [1, 2]. From the few studies, the prevalence of overweight and obesity among school-age children is growing in Sub-Saharan Africa, reaching over 10% [3-5]. The situation constitutes the double burden of malnutrition, which contributes to the increased risk of communicable and non-communicable diseases afflicting school children.

The UNICEF's conceptual framework explains the causes of malnutrition among children (Fig. 1.1) and serves as a starting point to design better strategies and programs to address it in Uganda [6]. Poor feeding practices and bouts of disease are the immediate causes of malnutrition. The limited consumption of nutrient dense foods compounds poor feeding practices, for example, the use of fortified foods, lack of dietary diversity, and lack of knowledge to care for the vulnerable groups. Underlying causes of malnutrition include limited household food security, inadequate maternal and childhood care, and access to sub-standard living environment. The basic factors include poor education (including foods and nutrition), inappropriate cultural favored practices, limited policy guidance on nutrition-related investment, low awareness of nutrition in national development agenda, and poor appreciation of evidence to inform nutrition policies and interventions. Basic factors magnify the underlying and immediate factors, therefore addressing basic and underlying causes can sustainably reduce malnutrition.

Several factors including household food insecurity, restricted access to clean water, and sanitation, and poor feeding practices or behaviors can contribute to undernutrition among family members [7, 8]. A recent study [9], revealed that only 4% of the rural population are threatened by severe food shortage and famine. The number of children that do not eat breakfast at home, however, is extremely high (92%), as is the number of children that do not eat at least one meal at school (70%) [9]. Poor quantity and quality of diets contribute to the high levels of malnutrition in the school-age group. From all schools that provide meals, three out of five do not provide fruits,

vegetables, fortified and animal foodstuffs [9]. To address these problems, Uganda has issued several policies and guidelines including the School Health Policy, the Uganda Guidelines for School Feeding, and Nutrition Intervention Program (GSFNIP), and the Uganda Nutrition Action Plan 2011-2016, which through education and awareness campaigns, promote school feeding programs in urban and rural schools [6, 10-12].

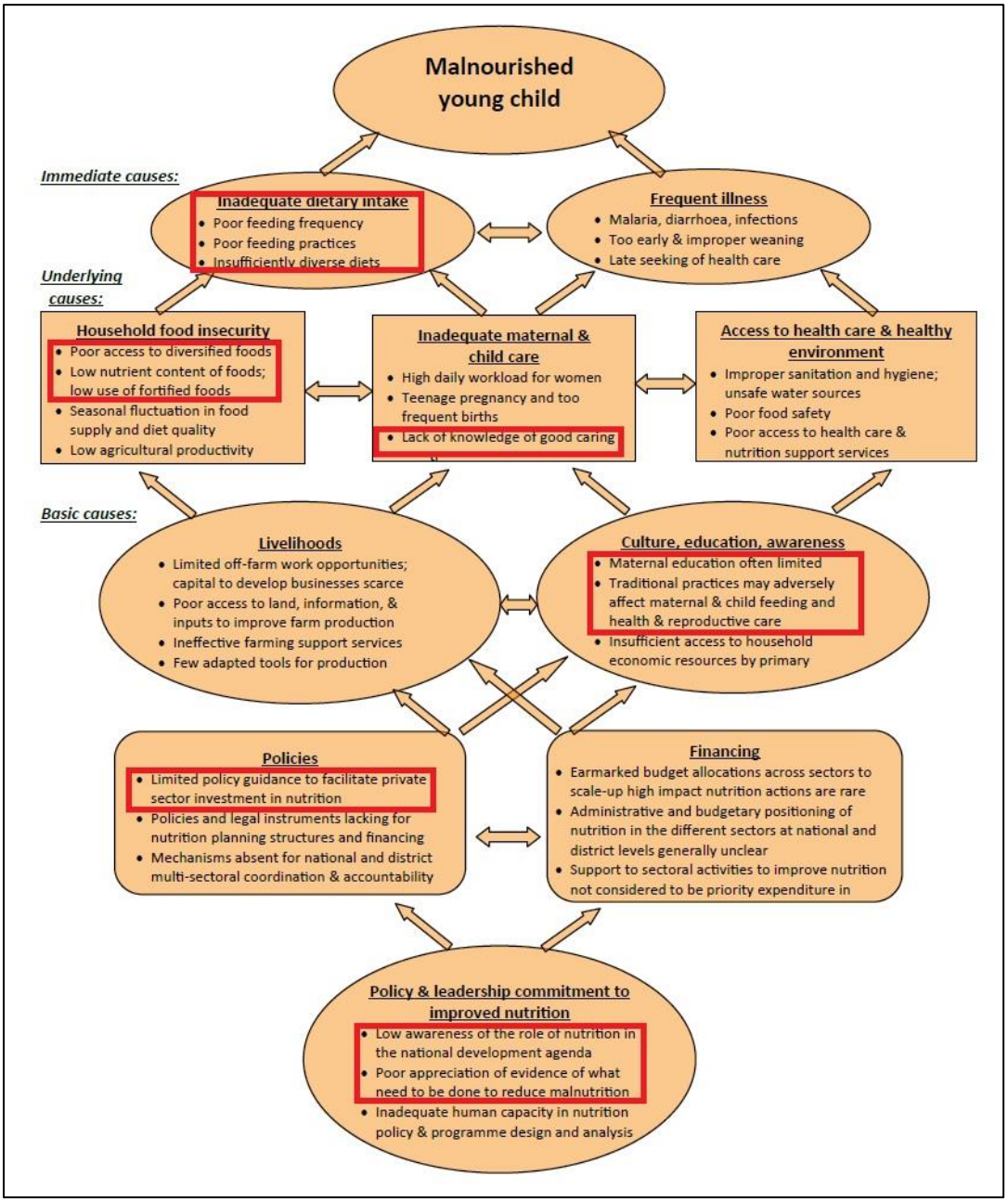

Fig.1.1. UNICEF conceptual framework for the causes of malnutrition [6].

The Guidelines for School Feeding and Nutrition Intervention Programs (GSFNIP) focus on many areas to improve the quality of life and academic performance of the school age group [12]. Focal areas include community and parent involvement, school feeding, nutrition education for behavior change in schools, nutrition, and care (e.g., physical activity and sports, deworming, immunizations, and nutrient supplementation), food storage, food preparation, food safety, and sanitation [12]. Although these guidelines are quite comprehensive and offer support to schools, the reality is different. Based on the current statistics related to the Uganda School Feeding Program and food consumption at homes and schools [1, 7-9], very few schools have adopted these guidelines, and many school-age children (70%) go throughout the day without meals [9]. These findings call for more efforts in the identification of the barriers to adoption of these guidelines and other nutrition strategies in schools. From the available literature, there are few studies [9, 13] on factors that directly or indirectly influence the adoption and implementation of the recommended school nutrition guidelines in Uganda.

Nearly eight million (> 80%) children aged 6-12 years, (i.e. one-fourth of the Ugandan population) are enrolled for primary education [9, 14]. The size of this captive audience presents a strategic opportunity to reduce the burden of malnutrition by centralizing and targeting nutrition interventions at schools. Also, it is a chance to implement the policy guidelines mentioned above. A few studies have focused on the effectiveness of nutrition interventions at schools to address malnutrition in Uganda [1,2,4]. These studies have targeted children who are the end beneficiaries of school nutrition interventions. However, limited studies [13] in Uganda have focused on the characteristics of individuals in the school setting, such as head teachers and teachers, who interact with students daily and are more likely to deliver both food and nutrition education to children.

As demonstrated in several well-conducted studies, nutrition interventions at schools that include nutrition education and food preparation training are useful approaches to increase awareness, modify attitudes, and support practices associated with good nutrition [15, 16]. In Uganda, one of the primary goals of the current GSFNIP and the Food and Nutrition Policy 2003 of the Ministry of Health (MoH) is to provide nutrition education and promote behavior change in the population [6, 9-11]. However, these strategies have implementation challenges including poor theoretical design to improve consumption behavior and lack of robust follow-up, monitoring, and evaluation strategies.

Most nutrition efforts have focused on addressing immediate, and to some extent, the underlying causes of malnutrition. Inadequate methods of evaluating nutrition interventions are a fundamental problem mapped in the UNICEF framework (Fig. 1.1). Indeed, many Sub-Saharan African countries, including Uganda, lack valid evaluation instruments to collect information that can inform policy makers and implementers in designing interventions to address the causes of malnutrition. More importantly, poor quality of data on nutrition indicators may contribute to failure to gain 245 quality adjusted life years, mainly attributed to nutrition awareness interventions [17]. Lack of robust nutrition awareness interventions can exacerbate malnutrition among vulnerable populations, including the school age group (6-12 years). Therefore, addressing policy challenges such as inadequate appreciation of evidence-based decision making and the role nutrition plays in national development agenda (Fig. 1.1), may have a multiplying effect beyond improving diet-related behaviors.

The determinants of diet-related behaviors include biologically determined behavioral predispositions, the experience with foods (physiological and social conditioning), Intra- and interpersonal factors, and the environment (Fig. 1.2) [18]. Knowledge is one of the key determinants of behavior, categorized within inter- and intrapersonal factors. Also, studies that have used theoretical frameworks such the Social Ecological Model, the Social Cognitive Theory, and the Cognitive Processing Model identify nutrition knowledge as a predictor of feeding behaviors and practices [19- 22]. Very few studies that have used theoretical frameworks in Uganda have given attention to nutrition knowledge as a determinant of feeding behavior and practices in educational institutions [13].

The studies in Uganda that have included nutrition knowledge as one of the determinants of behavior evaluated nutrition concepts specific to populations at risk such as infants, children, and women [23-25]. These studies focused on one or two components of nutrition knowledge such as nutrient requirements and nutrient deficiencies associated with illnesses. Unfortunately, the instruments used had different styles of questions (e.g. asking participants whether they have participated in nutrition training, define nutrition etc.), which make it hard to compare across studies, communities, and countries. For this reason, designing tools that include several relevant nutrition knowledge themes is critical to implementing effective nutrition promotion interventions in Uganda. Having the tool will enable agencies that want to explore factors that influence adoption of nutrition recommendations in schools of Uganda to collect nutrition knowledge of adults.

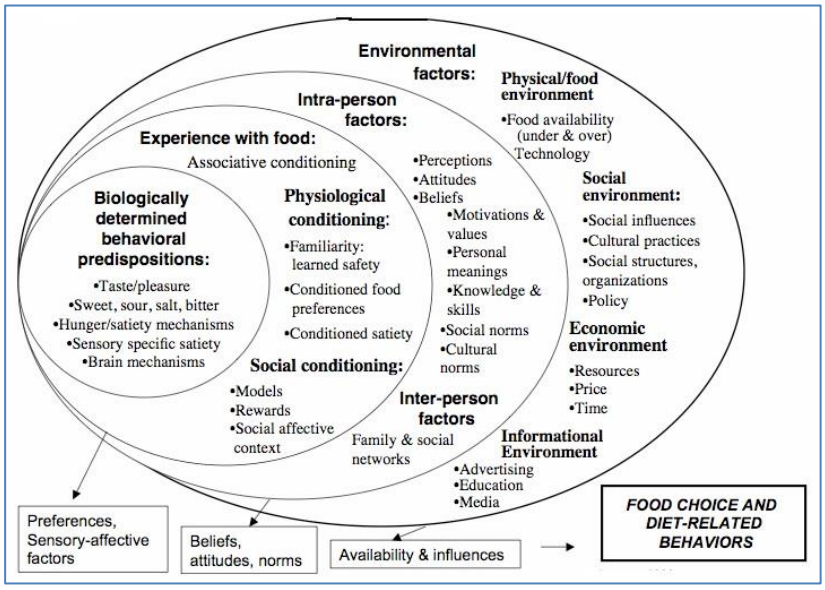

Fig.1.2. Determinants of feeding behavior [18].

Organized learning institutions, such as primary schools, are usual places to deliver interventions aimed at improving nutrition knowledge among children and associated communities. Schools in Uganda are hierarchically structured organizations, where the head teachers have executive authority. Due to their network and influence, this group is often requested to facilitate the implementation of policies and programs both at schools and in communities [26-28].

Head teachers are well positioned to initiate processes of nutrition behavior change and to address malnutrition in schools. They work together with stakeholders within the school environment including parents, fellow teachers, children, and the general community. Most head teachers manage the welfare of the children at schools by performing functions such as human resource management, leadership, financial management, and control, ensure effective teaching, ensure better learning achievement of teachers and students, and assets and record management [26-28]. Due to the different roles and responsibilities head teachers play, in and outside the schools, they are prime agents of behavior change. Head teachers, however, are among the groups with the lowest work incentives [29, 30], with limited access to continuing education [26], and who may not have enough basic nutrition knowledge to integrate nutrition interventions within existing school activities successfully.

Apart from the head teachers, another influential group is the community extension workers who are selected from within the communities. Like the head teachers, community

extension workers are uniquely positioned in communities to connect different sectors including education, health, and agriculture [31]. They are an integral component of the work that are involved in achieving public health and agricultural goals in low-and middle-income countries [32]. They are involved in reinforcing nutrition messages within the communities and bridge the human resource gaps created by shortage of experts in communities [32, 33]. However, there is no data on their understanding of nutrition concepts that could strengthen delivery of nutrition education interventions in communities and institutions like schools and hospitals.

Nutrition education interventions as recommended by the GSFNIP involve the integration into the existing school education curriculum to ensure sustainable dietary behavioral change. Nutrition education is *"a combination of educational strategies, accompanied by environmental supports, designed to facilitate voluntary adoption of food choices and other diet and nutrition-related behaviors conducive to health and well-being and delivered through multiple venues and activities at individual community and policy levels*" [18]. Before extensive nutrition education interventions are established to capitalize on the value of head teachers as agents of change, developing valid and reliable tools is critical to evaluate nutrition knowledge first for diagnostic purposes and later as a monitoring and assessment tool. Then, studies on factors that influence adoption of recommended school nutrition practices, such as nutrition knowledge of head teachers, can follow.

To explore nutrition knowledge and other factors that may affect the adoption of recommended practices in schools, the Diffusion of Innovation theoretical framework could be useful to identify and evaluate associated variables. The diffusion of innovation framework was made famous by Everett Rogers in his book *"Diffusion of Innovations"* [34]. This theoretical framework contends that action steps occur sequentially [35]. Potential adopters, for example, become aware of the innovation, which then facilitates the decision to adopt the innovation. Based on this theory, there are three types of decisions made in an organization: 1) *Optional,* in which individuals choose to or not to adopt an innovation, 2) *Collective,* in which after consensus, members choose to or not to adopt at innovation; and 3) *Authoritative,* in which decisions to or not to adopt an innovation, are made by few individuals [36]. Adoption assures implementation of innovation and thereby encouraging institutionalization or maintenance of the innovation over time by adopters or adoption units (Fig. 1.3). Diffusion facilitates the innovation to go through the mentioned stages within an organization or society. *Diffusion is a process by which an innovation,*

e.g., school nutrition guidelines, is communicated via particular channels over time among members of the social system [36]. The adoption of an innovation in an organization is a complex process that involves both the individual and organizational decisions to adopt the change. The diffusion leads to information exchange. It includes individuals having knowledge and experience to use the innovation sharing with people who do not know how to use and neither have experience with the innovation [36].

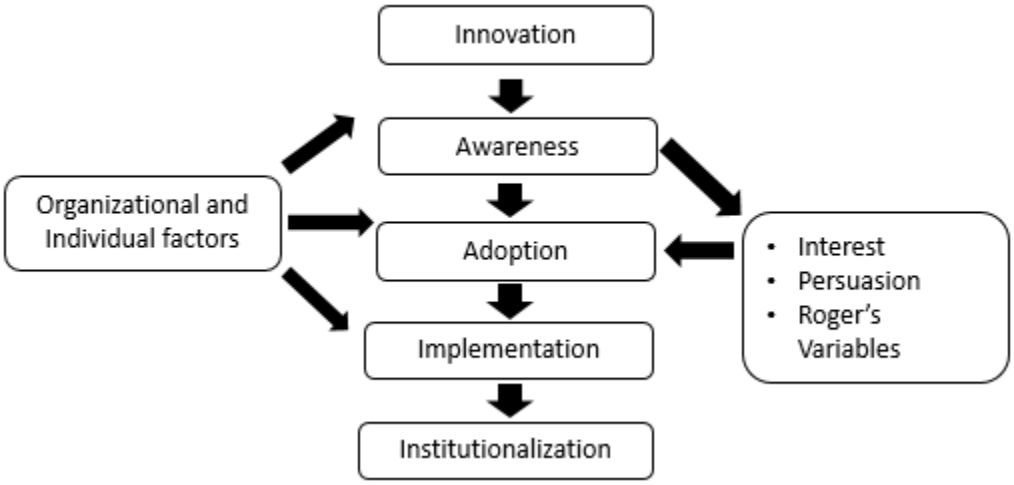

Fig. 1.3. Adoption of innovations in an organization [35].

An individual can adopt an innovation or it can diffuse within the organization depending on several innovation characteristics, which are referred to as Roger's adoption variables. These characteristics are: a) *Relative advantage*, which explains that an innovation with a clear, unambiguous advantage in terms of effectiveness or cost-effectiveness is adopted and implemented faster; b) *Compatibility,* in which innovations that match with the adopters' values, norms, and perceived needs are easily adopted; c) *Observability,* in which innovations with visible benefits to intended adopters are quickly adopted; d) *Trialability*, which argues that those innovations that can be tested by the intended users on a limited basis are adopted and assimilated more easily [34,35]. Interestingly, *prior knowledge* of the potential adopter features among other notable characteristics of innovations that are adopted easily or quickly [34].

There are other factors associated with the individual and the organization that can influence adoption. At the individual level, some factors are: a) *Likelihood to test and use innovations* includes intellectual ability, tolerance of ambiguity, motivation, values, and learning style; b) *Context-specific psychological antecedents* such as the adopter's motivations and self-

efficacy (e.g., values, goals, specific knowledge and skills, among others); c) The *adopters' meaning to innovation* such as adopters understanding of innovation to changing their lives ; and d) *Concerns at all stages of adoption* such as having sufficient information of using the innovation before it is introduced. Some organization characteristics that might influence adoption are: a) *Presence of homophilous individuals* or individuals with similar characteristics or common goals; b) *Presence of leadership and champions* or influential people connected with social networks; c) *Formal dissemination programs* such as those managed by the operational unit or the human resource group; and, d) *Professionalism and people with professional knowledge*, in which the organization hires a specific group to help influence or bring about buy-in for new technologies and innovations and support their diffusion. Other organizational characteristics include receptiveness of people, time and other resources, inter-organization relations (e.g., etiquette, dynamics, and core regulations) [34].

In the case of applying the Diffusion of Innovation framework to the implementation of nutrition programs at schools, the role of prior nutrition knowledge of influential or leading adopters (e.g., head teachers) of innovation might be an important influencing factor for the adoption of guidelines in schools [34, 38, 41]. Importantly, head teachers play different roles and can make individual, collective, and authoritative decisions about health and nutrition programs at schools, making them critical agents of change.

None of the studies that evaluated factors influencing adoption of food and nutrition guidelines for schools included knowledge of head teachers (principals) or any other school stakeholder (e.g., teachers, parents, or children). In addition, there is limited information on nutrition knowledge of specific adult populations as well as valid survey instruments to collect it in Uganda. Such instruments are also important to assess nutrition knowledge for the evaluation of current and future nutrition programs. ***Therefore, the objective of my dissertation work was two-fold: 1) to develop a tool to obtain valid and reliable basic nutrition knowledge data among adults including head teachers and community extension agents, and 2) to examine the potential role that the nutrition knowledge of head teachers plays as an influential factor for the adoption of the recommended school feeding practices in Uganda.***

1.2 Long-term Goal, Research Objective, and Specific Aims

The author's *long-term goal* is to improve nutrition among the school age group in Uganda. The objective of this study was: 1) to develop and validate a survey instrument in order to evaluate basic nutrition knowledge among adults, especially head teachers and community extension agents who are often responsible to disseminate and implement nutrition-related concepts in schools and communities; and 2) examine the potential role that nutrition knowledge of head teachers play as an influential factor in the adoption of recommended school feeding practices in Uganda.

Development of valid data collection tools is not an easy task as it requires a critical understanding of the following steps: 1) A review of available literature from Uganda and elsewhere; 2) Identification of the nutrition domains that appropriately define nutrition knowledge; 3) Collection of several items that describe each topic; and, 4) Assessment of the validity and reliability of the domains and items in the drafted instrument. In the absence of valid survey tools that followed the above steps, it is necessary to start the process with available valid instruments, which could be modified and validated for the population of interest [37]. Topics and items to evaluate nutrition knowledge from previous studies were used to obtain a draft questionnaire, which underwent the validation process. The study's *central hypothesis* was a revised questionnaire originally developed for the United Kingdom could collect valid and reliable data on basic nutrition knowledge among adults including head teachers and community extension agents in Uganda. To achieve the research goal, the following aims were sequentially executed.

AIM 1: Determine the content and face validity of the GNKQ to evaluate nutrition knowledge of head teachers in Uganda. For evaluation of content validity, a panel of experts (n = 5) in the several fields related to nutrition (agriculture, education, health, and nutrition) evaluated a set of nutrition knowledge topics of the initial draft of the GNKQ twice. Face validity was attained by administering the second draft of the GNKQ to fifteen head teachers and twelve health workers and conducting focus group discussions (n = 3 groups) with the same individuals. The results helped to obtain the third draft of the GNKQ that was used to evaluate nutrition knowledge among adults (i.e., head teachers and agricultural extension agents) in Uganda.

AIM 2: Determine the construct (concurrent) validity, internal consistency, and test-retest reliability of data obtained using the nutrition knowledge questionnaire. Determining concurrent validity, internal consistency, and test-retest reliability involved administering the third draft of the GNKQ to two population groups, college students (nutrition n = 40; engineering n = 37) and forty head teachers from primary schools in Kampala (government n = 23; private n = 17) at two-time points within two weeks. Experts in AIM 1 were consulted again after obtaining results to discuss the elimination of specific items and nutrition topics. This resulted in the fourth draft of the GNKQ.

AIM 3: Determine the internal consistency and test-retest reliability of the GNKQ applied to a larger sample of head teachers of primary schools in the Mukono and Wakiso Districts. The study recruited a large sample of head teachers (n = 255) located in two geographical areas, Mukono and Wakiso. The internal consistency and test-retest reliability were obtained. The reliable questionnaire data was used to characterize the level of nutrition knowledge among head teachers, which was disaggregated by gender, availability of school meals, school type, and location (rural vs. urban).

Aim 4: Determine the external validity of the GNKQ by applying it to community extension agents in Kiboga and Kyankwanzi districts. The study recruited community extension agents (n = 80) serving under Bioversity International, an international non-governmental organization, and the District Agricultural Office. The community extension agents completed the GNKQ twice within two weeks. Internal consistency and test-retest reliability were obtained to determine if the items in GNKQ could collect reliable nutrition knowledge data using agricultural extension agents.

AIM 5: Evaluate the influence of head teachers' nutrition knowledge on adoption of the Guidelines on School Feeding and Nutrition Intervention Program (GSFNIP) in Uganda. The Diffusion of Innovation framework [36] modified in another study [38] was used to explain the effects of personal characteristics of head teachers (nutrition knowledge, teaching, and administration experience) and school organization context on adoption (awareness and implementation) of the GSFNIP. The study targeted the same

sample of head teachers in AIM 3, but only used data from those (n =218) that completed the questionnaires.

1.3 Rationale and Significance

The results of this study are significant because psychometric measures were used as the basis for validating general nutrition knowledge questionnaire, which can allow scientists and public health officials alike to adequately evaluate nutrition knowledge on several topics of critical importance for Uganda's future. Particularly this study aligns well with the Feed the Future goals such as to increase access to nutrition services and social and behavior change messaging, and support policy making aimed at improving nutrition. The results of this study complement efforts by Uganda government agencies and different partners including US Agency for International Development (USAID) in delivering services to the Ugandan communities by strengthening monitoring and evaluation of nutrition education interventions.

In the Uganda Nutrition Action Plan (UNAP) numerous stakeholders are mentioned including Members of Parliament (MPs) and other political leaders, District Nutrition Coordination Committees (DNCC), faculty at institutions of higher learning, among others. Briefly, the roles of different stakeholders include nutrition information dissemination, planning of nutrition activities, and research. There is an assumption that the stakeholders have prior nutrition knowledge to facilitate or implement the above responsibilities. However, no real evidence supports, even tangentially, this assumption. Therefore, the validated GNKQ can be used to evaluate nutrition knowledge of some of the above implementing stakeholders. The instrument could be modified and expanded to other adult groups in Uganda such as healthcare workers and those mentioned in the UNAP. Using valid and reliable data will enhance effective planning, implementation, and impact evaluation of the UNAP.

In 2011, the Ugandan government developed the Guidelines for School Feeding and Nutrition Intervention Program. Nonetheless, few schools have adopted and implemented these guidelines. For example, some schools (40%) have no school meals program [9]. The schools that provide meals do not include fruits, vegetables, and fortified food, and even fewer schools do not have nutrition education activities or vegetable gardens as recommended by the guidelines [9]. Moreover, nutrition education programs that promote physical activity in schools can address the increasing incidence of obesity and non-communicable illnesses such as diabetes and

cardiovascular disease within school communities [39-41]. These, however, are minimally supported by government and school stakeholders including parents [9]. These gaps point to a need for further research, for example, on identifying some of the barriers [13] to adopting and implementing the mentioned guidelines. This study was, therefore, unique as it examined the characteristics of head teachers (including their nutrition knowledge) and schools that might influence the adoption of the recommended guidelines for school feeding and nutrition intervention programs in Uganda.

Lastly, this study contributes to nutrition literature on validation of questionnaires in three ways. First, there was hardly any nutrition knowledge validation study that quantified content and face validity. The author employed techniques of content validity index measures that are used in other disciplines to quantify content and face validity [42]. Second, the author also used Gwet's AC1 to determine interrater reliability. Gwet's AC1 has advantages over the commonly used statistics such as Kappa as it is a more stable statistic when data from few respondents are used, when there is a high prevalence or extreme agreement among experts, and when using categorical data [43]. Finally, the Diffusion of Innovation theory that was used to explain factors related to the adoption (awareness and implementation) of the GSFNIP has not been used extensively in the nutrition literature as in other disciplines, and more importantly, in the African context. Thus, comparisons of results using the Diffusion of Innovation with other areas are possible.

1.4 Dissertation Structure

This dissertation constitutes seven chapters. Chapter 1 is composed of the Introduction which provides the background information on the project, the goal and specific aims, and the rationale and significance. Chapter 2 represents a literature review of the available evidence on general nutrition knowledge among adults and methods used in the process of validation of instruments. Findings in Chapter 2 points to gaps in nutrition knowledge and validation research in Uganda and Africa as a region. Also, the literature review provides the reader sufficient background knowledge to understand the theoretical basis of the conducted research. Chapter 3 to 6 consists of field studies to design and validate the questionnaire. Chapter 3 involves identification of items that evaluate nutrition knowledge included in the first draft of GNKQ. Chapter 3 also provides results of the first pilot survey, in which internal consistency and test-retest reliability are determined. Chapter 4 is a follow-up study that recruits a larger sample of head teachers and

evaluated the internal consistency and reliability of the GNKQ obtained in Chapter 3. Chapter 4 presents data on nutrition knowledge of head teachers, which is disaggregated by individual and school demographic characteristics. Chapter 5 reveals that the GNKQ can obtain reliable data on an adult group other than head teachers in Uganda. The GNKQ produced results with acceptable reliability in a sample of community extension agents. Chapter 6 demonstrates nutrition knowledge as one of the factors that influence adoption process of the Uganda Guidelines on School Feeding and Nutrition Intervention Program. The results in Chapter 6 show nutrition knowledge of head teachers as an important element to consider in the adoption process of nutrition guidelines in schools. Chapter 7 summarizes the findings from each of the previous chapters and provides future directions for this research.

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CHAPTER 2: LITERATURE REVIEW

2.1 Summary

The fundamental aim of this literature review is to provide the reader with sufficient background knowledge to understand the theoretical basis of the current research. Literature in the areas of malnutrition in school population, nutrition knowledge, the Diffusion of innovation framework and validation were reviewed to explain the importance of using questionnaires whose results have been validated. The following questions were explored:

1. What is the magnitude of malnutrition and poor feeding practices among school population in Uganda?
2. What opportunities are available to head teachers to effectively address malnutrition in schools?
3. Can general nutrition knowledge of head teachers influence how they deliver adequate nutrition in schools?
4. What is the quality of the available data on nutrition knowledge of head teachers and how can it be improved?

The government of Uganda has formulated several nutrition policies and guidelines that target school children including the Uganda Guidelines on School Feeding and Nutrition Intervention Program [1, 2]. These guidelines are supposed to be disseminated and implemented in schools by the different stakeholders who are directed by school administrators or head teachers. Innovations (for this case the guidelines) are more likely to be adopted if stakeholders have prior knowledge and understand the concepts behind the innovation [3]. Head teachers are positioned to better influence adoption of several practices as they manage daily school activities, plan for school improvements, and are involved in human resources recruitment among other activities [4, 5, 6]. They are central to implementing any school nutrition intervention. With very few exceptions, nutrition education has been absent from most school curricula. Moreover, there is limited information on the current understanding of basic nutrition concepts in most population groups. This study reviews the literature on nutrition knowledge of head teachers and identifies methods and tools to evaluate it. Concepts on validation of questionnaires especially targeting nutrition knowledge are reviewed.

2.2 Structure of the Education System in Uganda and Enrolment in Primary Schools

Uganda educational system has four levels of formal education. Education starts at 4-5 years of age in pre-primary. Then, it continues with seven years of primary education and six years of secondary education, which is split into four years of lower secondary and two years of higher secondary [7]. Students can join tertiary education institutions including technical institutions and universities. There are over 22,500 primary schools in Uganda [8]. About 92% of the schools provide full-day programs, 7% offer partial-day programs, and 1% of establishments provide full-time boarding programs. Over eight million children enroll in primary schools, of which 86% and 14% of the children are in government-aided and private schools, respectively [9]. About 50% of the children who enroll in primary schools are girls. The age of entry into primary school varies from five to seven years. Government expenditure on primary education is 3.3% of the Gross Domestic Product (GDP), which is below the United Nations Educational, Scientific and Cultural Organization (UNESCO) benchmark (6%) [10].

2.3 Nutrition Status of School Children in Uganda

Despite the large proportion of the school age group (6-12 years) related to the general population (21.3% of 34.6 million) [11], the nutrition status of school-age children has remained poor and neglected. About 22 to 38% of the school-age children are stunted and 5-42% are underweight. There are high rates of micronutrient deficiencies in this age group as well [12, 13]. Over 38% of children are anemic, while over 80% are iron deficient [12, 13]. Also, 3.4% and 30% of the school-age children present iodine and vitamin A deficiency, respectively [12]. The prevalence of overweight and obesity among school-age children has increased to 10% in the last decade [14-16]. This constitutes the double burden of malnutrition, which contributes to the increased risk of communicable and non-communicable diseases afflicting this very age group.

The poor nutrition status is attributed to poor feeding practices in this age group. Reports show that 92% of the rural children in schools do not have breakfast before they come to school [17]. Additionally, 70% of day school children do not receive or bring meals at school. Such statistics may contribute to reduced attendance, attrition, or demotivation of children to participate in class and hence affect their academic performance.

Evidence from other countries on nutrition education and practices in school feeding program are mixed. In Peru, for example, breakfast given to children improved energy, protein,

and micronutrient intakes [18]. In the same systematic review, only a few studies found a positive effect of school feeding on children's growth, anthropometric indices, and body composition, while in others there was no effect. In another systematic review, some studies reported increased physical activity and improvement in parental involvement [19]. In South Africa, there were positive perceptions on the benefits of School Nutrition Program, however, there were no reports on improved nutritional intake [20]. In Kenya, students in the school feeding program had lower rates of anemia and improved growth [21]. In Finland, the school meals improved nutrient intake among the children in the disadvantaged populations [22].

The progress made against poverty in Uganda has not affected school nutrition. The poverty rate as explained by earning less than 1.25 dollars declined from 56.4% in 1992 to 19.7% in 2013 [23]. Poverty reduction contributed to improved food security among Ugandan households, in which only 4% are threatened with extreme food shortages and famine [17]. Therefore, studies are needed to understand why with better economic achievement, school population has been neglected and devoid from sustainable school feeding programs in Uganda.

2.4 School Initiatives Associated with Feeding Children

Although there are many primary schools (60%) that have mobilized their communities to provide school meals, they face a series of challenges such as low political support and participation [17]. Establishments that do not provide meals (40%) use other modalities for children to access lunch, for instance, students bring packed meals from homes, buy food from vendors, or send children home to have some food or even send them home early (half day) [17]. In the case of packed meals, the responsibility lays on the parents, who at times pack lunches with limited consideration of nutrient content and safety options in addition to high cost [24, 25]. Household constraints such as unavailability of surplus food, appropriate packaging materials (e.g., wrapping paper, plastic or paper lunch containers), and unsuitability of available food (e.g., juice, bread, cooked foods) for packing are prevalent among children with packed lunches at schools [17]. Food vending is another option [26] but is limited to the few parents capable of providing daily cash to children [17]. These challenges require the adoption of a clear communication strategy that promotes school meals and informs the value of school meal programs to policy-makers and communities.

Apart from establishing different options of feeding children while at school, different food items have been recommended and used in schools to improve their nutritional value. Some of the food items include orange-fleshed sweet potatoes, milk, fortified foods, and eggs [2, 27]. It is important therefore that individuals promoting such food items have a working knowledge of nutrition concepts and the value of the different food items so they can help communities make informed choices. However, nutrition knowledge is not enough. Often school meals are part of larger, integrated programs that include hygiene and sanitation, nutrition awareness, immunization and deworming, nutrient supplementation, and school gardening [2]. These programs have significant success as they tackle several issues afflicting the population. For instance, primary health clinics that offer influenza vaccinations in school environment have been successful [28]. Nutrition awareness programs are impactful as children expand their food experiences during school meals with the existence of kitchen and vegetable gardens [29]. Cross contamination in school meals can be reduced by improving food handling practices among stakeholders of school lunch programs [30]. Deworming and iron supplementation have been easily integrated into the school lunch program to address anemia with small to medium effects [31]. It is therefore imperative that stakeholders implementing school lunch program understand basic nutrition concepts along with other important practices associated with health interventions integrated into the feeding program.

2.5 Frameworks Used for Diffusion and Implementation of Policy Recommendations to Schools

In Uganda, health school policies are the responsibility of the Ministry of Education and Sports and the Ministry of Health. The process of implementing policies into practices in schools follow several potential communication pathways. Such communication pathways involve the Ministry of Education and Sports (MoES) that coordinates other ministries and government agencies to formulate and disseminate policy, monitor, and evaluate the implementation and mobilize resources [2]. The communication strategy involves other key ministries and departments at the national level such as the Ministry of Local Government, Ministry of Health, President's Office, and the Parliament. There also different development partners who support government initiatives. The national level agencies provide guidance in terms of policy to the district level. At the district level, district leadership supports schools through the District Education Office, which

instead coordinates with individual schools through their head teachers along with School Management Committees (SMC). The communication from the head teachers then reaches the school stakeholders i.e. parents, teachers, and students. Normally, ministries or programs do not use theoretical frameworks to disseminate policies in schools, especially for nutrition guidelines.

Diffusion of Innovation

The Diffusion of Innovation theoretical framework can help to explain how, why and at what rate nutrition guidelines diffuse in schools and communities [32, 33]. *Diffusion* is the process by which an innovation is communicated through certain channels over time among the members of a social system [32]. There are four elements in this framework namely innovation characteristics, communication channels, exposure time, and the social system (Fig. 2.1).

Innovation is defined as an idea, practice, or object that is perceived as new by an individual or another unit of adoption. Most innovations are technological innovations that might include a hardware and/or software. The technology reduces uncertainty in a cause-effect relationship in achieving the desired outcome [32]. The hardware aspect consists of the tool that embodies the technology as a material or physical object. Examples of hardware type nutrition technologies include fortified foods, biofortified foods, iPads, sensors, and phones [2, 34, 35]. The software aspect consists of information base of the tool. Software type nutrition technology includes programs for menu planning, diet assessment, weight loss app and nutrient analysis [35-39]. The *innovation characteristics* as perceived by members of the social system determine the rate of adoption. The major perceived attributes of the innovation include relative advantage, compatibility, complexity, trialability, and observability [32]. *Relative advantage* is the degree to which an innovation is perceived to be better than existing one. The higher the relative advantage the faster the innovation is adopted. *Compatibility* of innovation is the degree to which an innovation is perceived to be consistent with existing values, experiences, and needs of potential adopters. *Complexity* is the degree to which an innovation is perceived difficult to use. *Trialability* is the degree to which an innovation is experimented on a limited basis. Finally, *observability* is the degree to which results of innovation are visible to others. In addition, the *reinvention* of the innovation is the degree to which an innovation is changed or modified by the user in the process of adoption.

The *communication channel* is how messages get from one individual to another [32]. The communication channels include mass media and interpersonal channels. Each communication channel has unique advantages. Mass media channels such as radio, television and newspapers are more effective in creating knowledge about innovations. Interpersonal channels such as face to face or virtual exchange between individuals are effective in persuading an individual to accept the innovation. They are effective in changing attitudes towards an innovation and influence the decision to adopt or reject the innovation. Most individuals subjectively evaluate the innovation through peers who have adopted the innovation [32]. The attributes of the individuals interacting may also affect the decision process to adopt the innovation. *Heterophily* is the degree to which two or more individuals interacting are different in certain attributes such as their education, beliefs, and socio-economic status. *Homophily* is the degree to which two or more people interacting are similar in certain attributes. Communication of innovation through homophilous individuals is more effective while in heterophilous individuals comes with challenges. An example of heterophilous exchange happens when trainers who are more learned than the communities they serve, speak in technical jargon only known to them. Such challenges are solved by identifying individuals within the community (e.g., opinion leaders) who can interact with fellow community members to influence their decision about the innovation.

Time is involved in the diffusion of innovation as it influences the *innovation-decision process, the* category of individuals' *innovativeness,* and the *rate of adoption* [32]. *The innovation-decision process* (adoption process) is an information seeking and processing activity in which individuals (or other decision-making unit) goes through the first understanding or knowledge about the innovation, to the formation of attitudes towards the innovation, and thus, leading to a decision to adopt or reject the innovation [32]. The innovation-decision process follows five steps in a time ordered sequence (Fig. 2.1). First, knowledge about the innovation (awareness-knowledge), where an individual learns about the existence of an innovation and gains information on how it functions. Some studies have referred to knowledge about the innovation as awareness [3]. At the knowledge stage, someone wants to know what, how, and why the innovation works and therefore mass media channels of communication can be used. Next, at the persuasion step, the individual wants to know the innovation advantages and disadvantages for their specific situation. Interpersonal communication channels such as peer interactions are likely to fulfill the needs of potential adopters. Third, the individual may decide to adopt or reject the innovation

depending level of benefit to their situation. Next, at the implementation step, the individuals use the innovation. Even at this step, however, there might be some level of uncertainty. Finally, at the confirmation step individuals seek to reinforce the decision they made i.e. adoption or rejection and any option taken is long term.

Time or the innovation- decision period is required through all the above steps. The innovation-decision process in an organization is complicated because of the larger number of individuals who decide and the limited time is normally allowed for such innovations to bloom. Another time influenced variable is *innovativeness*, which is the degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than other members of the social system [32]. The adopter categories include the innovators, early adopters, early majority, late majority, and laggards. Innovators are active information seekers, exposed to high degree mass media and interpersonal network, cope with the uncertainty of the innovation, and first to adopt the innovation. The *rate of adoption* is also influenced by time taken to adopt the innovation. The curve relating adoption (%) versus time follows an s-shaped pattern. At first only a few individuals take up the innovation, who are mainly the innovators. Soon after, more people start adopting it. Finally, the rate of adoption levels off. Although most adoption curves are s-shaped, the rate of adoption is different for each innovation and under different situations.

A *social system* is defined as a set of interrelated units that are engaged in joint problem-solving to accomplish a common goal [32]. The social system constitutes a boundary within which an innovation diffuses. It involves how the social structure affects diffusion, the effect of norms on diffusion, the roles of *opinion leaders and agents of change*, types of innovation decisions, and the consequences of innovations [32]. Opinion leadership is the degree to which individuals can influence others' attitudes and overt behavior informally in a desired way with relative frequency. A change agent is an individual who influences other peoples' innovation-decision in a direction desired by the agency. There are four major types of innovation-decisions. *Optional*, in which choices to adopt or reject an innovation depend on the individuals and are independent of other members in the social system. *Collective*, in which the decision to whether adopt or reject is made by consensus among members of the social system. *Authoritative*, in which choices to adopt or reject an innovation are made by relatively few people or by an individual with power, status, and expertise. Finally, *contingent*, where choices to adopt or reject are made after a prior innovation decision and it combines two or three of the first innovation decisions. The social system influences

diffusion concerns and consequences that occur to an individual or group upon adopting or rejecting the innovation.

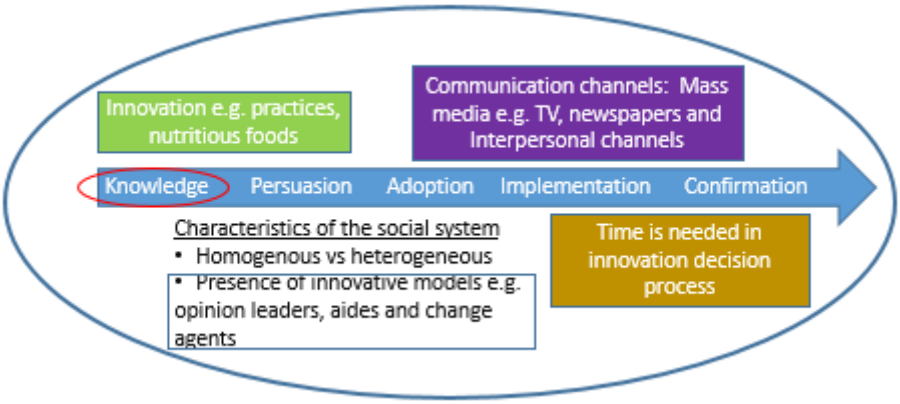


Fig. 2.1. Illustration of adoption process and elements of diffusion in a social system [32].

In addition to the above elements that influence diffusion, Greenhalgh et al., [3] added a number factors that may affect the adoption process. A similar framework such as that of Rogers (2003) [32] of awareness to adoption implementation was used in Greenhalgh et al., (2004) review [3]. For the case of simplifying them in the current study, they were classified into attributes of the innovation, the adopters, and social systems.

Some *attributes of innovations* discussed in the review [3] include the innovation's *hardcore* and *soft periphery* elements. Hardcore are irreducible elements of the innovation. Soft periphery elements are the organization structures and systems required to implement the innovation. As it is difficult to influence the hardcore element, the more adaptive is the soft periphery, the easier the innovation is adopted. The *risk* involved in adopting the innovation is another attribute. The higher the degree of uncertainty the less the innovation will be adopted. The relevance of the innovation to the performance of the organization is also important for its adoption. If the *knowledge to use* the innovation is available and can be transferred from one context to another then, the innovation will be easily adopted. Finally, most innovations will be adopted if they come with *support* in the form of manuals or formal training [3].

The *adopter attributes* include the *general psychological antecedents* of potential adopters associated with the propensity to try out an innovation include tolerance of ambiguity, intellectual ability, motivation, values, and learning style. *Context-Specific psychological antecedents* argue that the intended adopter who is motivated and able (in terms of values, goals, specific skills, and

so on) to use an innovation is more likely to adopt it [3]. The *meaning* attached to the innovation by the intended adopter influences the adoption decision. The higher the meaning attached the more likely the innovation will be adopted. *Concerns in the preadoption stage* might discourage intended adopters. They should be aware of the innovation and have sufficient information about what it does and how to use it; and are clear about how the innovation would affect them personally before adoption [3]. *Concerns during early use* should emphasize visible outcomes. Successful adoption is more likely if the intended adopters have continued access to information about what the innovation, training, and support on using the innovation early on [3]. *Adequate feedback* provided to adopters on the consequences of adopting the innovation will increase the rate of adoption.

The attributes related to the social systems include the *social networks* in which the potential adopters subscribe or participate and are key for adoption. Horizontal networks such as Facebook and Twitter are more effective for spreading peer influence and supporting the construction and reframing of meaning. Vertical networks such as any app on Facebook or My FitnessPal are more effective for cascading codified information and passing on authoritative decisions. *Harnessing opinion leaders' capacity* through training on the innovation and persuading others to adopt increases adoption. Identifying true opinion leaders for only an innovation (monomorphic opinion leaders) and opinion leaders influential for the adoption of different innovations (polymorphic opinion leaders) should guide the training. *Champions* for an innovation within an organization increases the chance the innovation is adopted. Champions might be i) the organizational maverick, who gives the innovators autonomy from the organization's rules, procedures, and systems so they can establish creative solutions to existing problems; ii) a transformational leader, who harnesses support from other members of the organization; iii) an organizational buffer, who creates a loose monitoring system to ensure that innovators properly use the organization's resources while still allowing them to act creatively; and iv) a network facilitator, who develops cross-functional coalitions within the organization [3]. *Boundary spanners* is a situation where individuals in the organization have significant social ties in and out of the organization, which increases chances of adoption. Organizations that support boundary spanning increase adoption of the innovation. Also, organizations with *formal dissemination program* increase chances that innovations are disseminated. Organizations assimilate innovations more readily if a) it is *large, mature, functionally differentiated* (i.e., divided into semi-autonomous

departments and units), and specialized, with foci of professional knowledge organizational members; b) it has *slack resources* to channel into new projects; and has decentralized decision-making structures.

For the case of this dissertation, a few of the above constructs used in the models of Rogers [32] and Greenhalgh and others [3] were applied together. The study by Deschesnes and colleagues [40] recruited principals to examine predictors to adoption of the Quebec Healthy Schools approach. The adopters' and schools' characteristics as well as perceived attributes of the Healthy School approach predict adoption were explored (Fig. 2.2). School organizational characteristics such as the presence of leaders within schools, perceived school contextual barriers, school investment in healthy lifestyles, and beliefs in collective efficacy have more weight in influencing the adoption of the Quebec Healthy Schools Approach. This group established that attributes of Healthy School approach were not strong factors that influence adoption. Chapter six, school and head teachers' (adopters) characteristics are examined as factors that influence the adoption of Uganda Guidelines on School Feeding and Nutrition Intervention Program using a modified model by Deschesnes and colleagues informed the systematic reviews by Rogers and Greenhalgh and others.

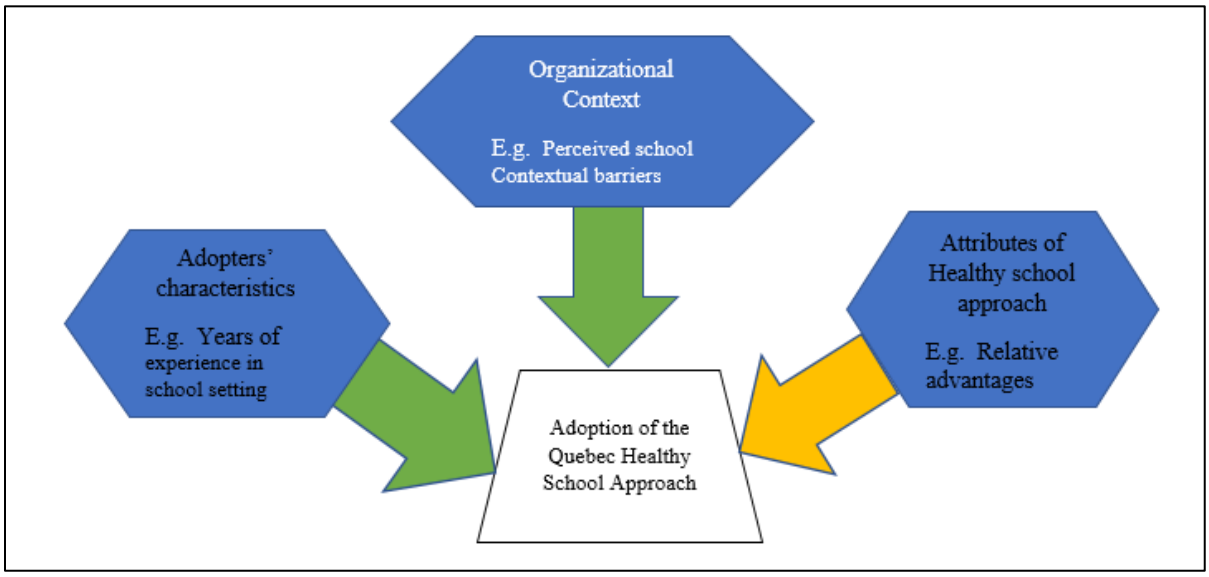


Fig. 2.2. Prediction model of schools' likelihood to adopt the Healthy School approach [40].

Opinion leaders and change agents in the Uganda school setting

Opinion leaders and change agents influence decisions during implementation of policies in the social systems such as schools and communities [40]. Opinion leaders influence other individuals' attitudes or overt behavior informally with relative frequency. They are found in the social system, are social models, are exposed to external communication, are of relatively of higher social class, and are at the center of interpersonal communication [3]. On the other hand, change agents influence client decision in a direction deemed desirable by an agency. They are mostly professionals with degrees and certificates and normally use the opinion leaders. In the case of implementing nutrition policies in schools, change agents and opinion leaders require adequate knowledge on basic concepts of nutrition to influence decisions of other members of local institutions and communities. In Uganda, there are different community resource persons including head teachers, teachers, community agriculture extension agents and health workers who embody the characteristics of leaders and change agents and can potentially support the implementation of nutrition policies.

Head teachers as opinion leaders and change agents

In general, head teachers manage the welfare of children at schools by performing functions such as human resource management, leadership, financial management and control, ensure effective teaching, better learning achievement of teachers and students, and assets and record management [41, 42]. It is reported that in Uganda head teachers make decisions that could be conducted unilaterally or in consensus with either the Parent Teacher Association or the School Management Committee (SMC). This is committee, in which the head teacher acts as the executive officer, oversees all school management functions at the primary-school level. A typical SMC is constituted of 12 school community members, six are appointed by the board of trustees or foundation of the school, including the chairperson. The remaining six consist of three local government representatives, one parent, one teacher and one student. The specific roles of the SMCs continue to evolve as educational policies are modified. Nonetheless, four distinct roles are clear: (i) financial management of schools, including budget approval and generation of new funding sources; (ii) infrastructure and property development, management, and maintenance; (iii) ensuring the discipline of learners and staff; and, (iv) school-level conflict resolution. Lately, SMCs has also been charged with school-level goal setting and planning and establishing

relationships with parents and the community. Head teachers alone are responsible for making decision on issues within the classroom (8.2%), school repairs (36.5%), financial support (18.1%), housing of staff (9.3%), procuring textbooks (29.1), chalk (54.4%), hire extra teacher (26.5%), and transfer of teachers (19.7%) (Fig. 2.3). They also decide on issues of school feeding program 17% of the times, second only to the SMC (36%), on which the head teacher is a member [42]. Finally, head teachers approve activities of school feeding most times (23.4%) compared to the SMC (23%) [42]. Therefore, head teachers influence functioning of school by making consensus (with SMC) and authoritative decisions.

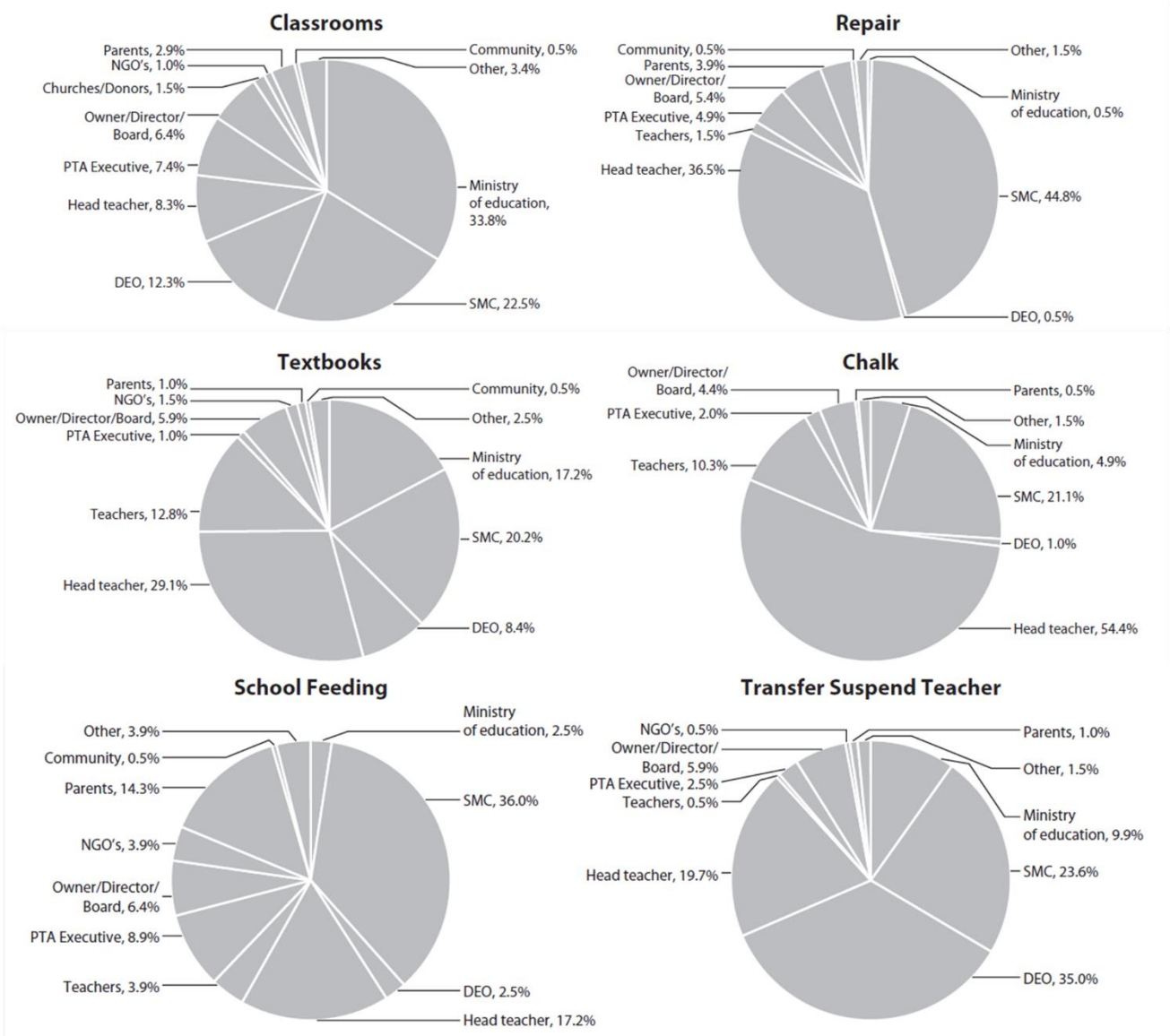


Fig. 2.3. Who makes decisions at the school level in Uganda [42].

Evidence that head teachers influence nutrition interventions

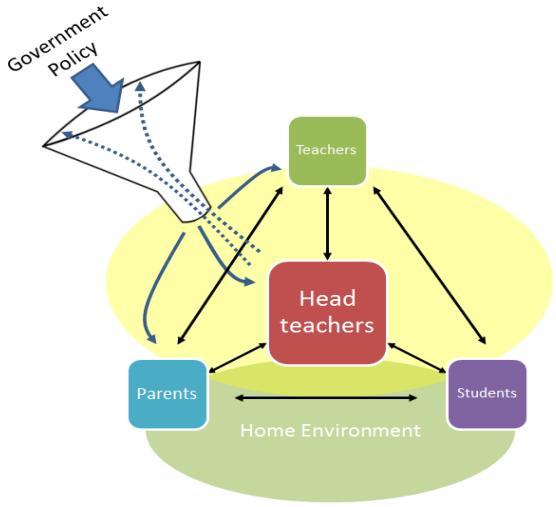


Fig. 2.4. Author's view of head teachers' as prime agents of behavior change at the center of school community.

Several nutrition studies that employed head teachers or school administrators were successful in modulating family and children's feeding behaviors [43, 44, 45]. School administrators can be regarded as a funnel to deliver government and development partners policies, programs, and projects to the schools and the communities through fellow teachers, parents, and students (Fig. 2.4).

Head teachers in Zambia and South Africa, for instance, participated in a nutrition education program. The activities included curriculum development, production of students' reading materials including books, appraisal of teachers' delivery of nutrition education in class, and monitoring of the different activities [43, 44]. This strategy promoted the involvement of parents in children's feeding and welfare and positive outcomes such as increased proportions of children that had breakfast before coming to school, of children whose parents packed food for school, and of family members that consumed vegetables at homes. In South Africa, training of educators in the Nutrition Education Program (NEP) improved their nutrition knowledge as well as that of the students [45]. It is also worth noting that other associations in the US such as the Academy for Nutrition and Dietetics, School Nutrition Association, and the Society of Nutrition Education and Behavior promote community-based participatory approaches, in which multidisciplinary teams work together to address malnutrition in schools. These teams consist of school staff, families, and other community members, who identify needs, develop feasible strategies to address priority areas, and integrate nutrition services [46].

A few studies have focused on how nutrition is delivered in schools in Uganda [12, 17]. These studies have mainly focused on characterizing the problems rather than the methods of evaluating the effectiveness of interventions provided to improve services of key community resource persons including head teachers. The nutrition knowledge of the head teachers, for

example, is not known and yet, as described above, this group can directly influence decisions made to implement nutrition programs in the school community.

Community extension workers as change agents

Community extension agents have a unique position, connecting communities to the different sectors including education, health, and agriculture [47]. Agents are increasingly recognized as an integral component of the health workforce needed to achieve public health and agricultural goals in low- and middle-income countries [47]. They are selected from or by their communities, a process that enhances trust and engagement in the assigned roles. Extension services have the potential to reinforce nutrition messages and educate farmers on the utilization of diverse crops and livestock for nutrition [48]. They bridge the human capacity gaps created by a shortage of experts in the communities [49].

Interventions that have involved extension workers have been impactful. In North Carolina, USA, a multidisciplinary team among which comprised of extension workers developed program materials and trained lay counselors on the delivery of nutrition interventions in schools. They were also involved in the design of the family intervention programs in Massachusetts [50]. This study did not report the impact of the intervention. However, in another program where extension workers were involved, elementary school children improved their liking of fruits and vegetables and increased acceptance of new menus [51]. In yet another study in schools working with extension workers, which recruited 40 elementary schools and 8,000 children, the proportion of children who ate at least one serving of fruits or vegetable a day doubled after 5-week intervention [52]. A one-year classroom-based nutrition education designed and delivered by the extension system in Maryland, USA led to improved diet-related behaviors in elementary children [53]. In this study, there were improvements in fruits and vegetable consumption during lunch, weekly consumption of fruits and vegetables, and self-efficacy to prepare lunches.

In the current extension services in Uganda, the National Agricultural Advisory Services (NAADS) model relies on the private and non-governmental organizations (NGOs) to provide extension services. The extension workers are recruited at the sub-county level, but there remain challenges to identify qualified human resources for these posts [54]. Therefore, community extension agents are important in disseminating agricultural and nutrition information to

communities and schools. More importantly, their nutrition knowledge and training should cover similar themes and practices as promoted by teachers and head teachers at schools.

The Diffusion of Innovation framework implemented in nutrition-related programs in schools and communities

The Diffusion of Innovation (DI) framework is widely and successfully applied in health, information technology, psychology, and medical education to explain the differences in the rate of adoption of innovations [3]. Although the framework finds wide use in other disciplines, it has not been used extensively in the nutrition field. It was successfully used in a study [55] to examine factors the influence adoption of nutrition-related interventions among institutional managers. It was revealed that adoption and implementation of nutrition guidelines in recreational facilities were related to the managers' nutrition-related knowledge, beliefs, and perceptions, as these shaped his decisions and actions. Another study [56] used the DI to demonstrate linkages between school management and communities in the adoption of recommended nutrition practices. Results showed the implementation of the daily physical activity and Food and Beverage Sales in Schools guidelines was facilitated by diverse perceptions such as that they were relatively advantageous, were compatible with school mandates and teaching philosophies, and had observable positive impacts and impeded when perceived as complex to understand and implement. The DI theory has also been used to study the implementation process of School Wellness Policy in the United States [57]. The Diffusion of Innovation framework was used to show that health promotion was important to increase physical activity opportunities for children in schools [58]. In that study, it was revealed that teachers involving family, community, and staff members as co-health promoters were important to increase physical activity engagement in schools. In another study [59], the framework was used to evaluate the Let's Go! project, which was a childhood obesity prevention program that established regional workgroups to develop innovative solutions to improve school meal programs. This program led to 77 schools achieving the Healthier US School Challenge and 130 schools implementing Smarter Lunchrooms techniques in the school year 2011–2012. A study [60] in Sub-Saharan African used the DI to investigate existing knowledge diffusion models and their limitations, available best practices, and their potential for translational research to augment extension service programs for agricultural practices. That study revealed that public-private partnerships were critical to forging ties between the research and farming communities. In this

case, researchers and the institutions need to consider the needs and priorities of the farmer first, however significant attention should be given to agent education, training, and face-to-face interactions. Moreover, translational research can bolster the existing knowledge diffusion practice, in which there is great potential for information communication technologies (ICT) in disseminating new knowledge and creating knowledge networks. The DI was used in a review [61] of developments in supportive policies, donor programs and diffusion status in all photovoltaic (PV) market segments in Kenya, Tanzania, and Uganda, and identified key factors that explained differences in the diffusion of solar home systems (SHS) in these three countries. These factors were: (i) the decline in world market prices for PV modules; (ii) the prolonged support from international donors; and (iii) conducive framework conditions provided by the three governments. Also, five key factors were identified in the literature to explain the higher level of SHS diffusion in Kenya compared to Tanzania and Uganda such as (i) a growing middle-class; (ii) geographical conditions; (iii) local sub-component suppliers; (iv) local champions; and (v) business culture. Finally, the DI framework was used to market and promote consumption of insects as an alternative source of animal-based meats [33]. The study revealed that overemphasis on changing values and unrealistic goals of insects as meat alternative hampered entomophagy's diffusion. The above studies show that although the DI framework can be applied to several settings, there is limited evidence that has used the framework in schools.

Limitations of the Diffusion of Innovation framework

Although the model of diffusion of innovation has shown potential to explain the process of adoption within specific settings, little is known about those factors resulting in non-adoption. It is possible that some people decide to use an innovation and later discontinue its use [62]. The literature on research on non-adoption is scarce and provides only deficiency factors. Non-adoption is always referred to negatively, however, in some cases it should be considered positive in cases where the new technology does not create a strong enough social acceptance or the purpose is to change from one accepted behavior to another. There is scarce evidence that the domains explaining diffusion can also explain non-adoption. Naturally, different innovations come with different factors that favor their adoption. Most of the studies assume that in the event of the innovation, its old version will be replaced, which is not the case.

Most evidence has focused on the relationship between the innovation and potential adopters. Less so on interactions between individuals that favor adoption. There is no complete explanation for the behavior of humans [62]. Previous innovation research is mostly sequential and simplistic, and often lacks the social interaction factors that also comprise the whole social system.

The diffusion framework originates from marketing and sociology disciplines. Both fields have numerous assumptions, for example, in marketing it is assumed that users adopt new technology to maximize their utility while in sociology to maximize social orientation [62]. The assumptions are contextual and may not be generalized to other disciplines including nutrition.

2.6 Nutrition Knowledge

In the previous sections, the author briefly discussed the value of knowledge about the innovation. This is referred to as awareness-knowledge, which is one of the three knowledge types needed by adopters [32]. There are three questions that come with the innovation: "What is the innovation?", "How does it work?", and "Why does it work?" These questions represent the three types of knowledge. The first type is *awareness- knowledge,* which deals with the information that the innovation exists. This type of knowledge may motivate potential adopters to seek the other types of knowledge. The second is the *How-to-knowledge* which consists of information on how to use the innovation securely, correctly and in cases of complex innovations. When how-to-knowledge is not obtained before the adoption of innovation, rejection and discontinuance are more likely. There are few studies that have included the how-to-knowledge as a variable. The third type is *principles-knowledge* which consists of information dealing with the functioning principles underlying the how the innovation works. An example is the germ theory, which underlies the functioning of boiling, vaccination, and use of latrines (innovations) to reduce bacterial infection (benefit). For this study, principles-knowledge is nutrition knowledge which underlies the functioning of nutrition interventions such as school feeding, nutrition education and fortification among others. Rogers (2003) points out that it may be overpassed to adoption, but there are dangers of misusing the innovation [32]. Most change agents perceive principles-knowledge as beyond the scope of their work and only obtained from formal education. Change agents tend to spend longer time on potential adopters through the innovation-decision process because when they lack principles-knowledge.

General nutrition knowledge, which is both a how-to- and principles-knowledge is one of the determinants of behavior that is often studied in low-income countries [63- 66]. However, in Uganda nutrition knowledge has been poorly evaluated because of its narrow and varying definitions and lack of validated tools. Nutrition knowledge, broadly defined, refers to:

> "Knowledge of concepts and processes related to nutrition and health including knowledge of diet and health, diet and disease, foods representing major sources of nutrients, and dietary guidelines and recommendations" [67].

Other dimensions of nutrition knowledge included in previous studies are related to food storage, preparation, and use of food labels [67, 68]. From a review of the literature in Uganda, none of the published studies have used a variety of dimensions to define nutrition knowledge. The ones available did not apply validated questionnaires [63- 65]. Uganda has many community resource persons (e.g. head teachers and health care workers), who often provide nutrition extension services. Nonetheless, the effectiveness of performing their duties in the communities has not been evaluated, even less so their nutrition knowledge. This may increase the inefficiency of the nutrition education interventions in schools and communities, and adds to the confusion surrounding nutrition concepts.

Nutrition knowledge potentially influences behaviors

Studies relating nutrition knowledge and behavior have yielded conflicting conclusions. Some studies suggest nutrition knowledge, directly and indirectly, influences behavior while others do not show any significant impact. A study [69] on the association between nutrition knowledge and eating behavior in adolescents, found there was no association between nutrition knowledge and food choice among sixth graders. However, there was a significant correlation of nutrition knowledge in girls and boys of the seventh and eighth graders. Another study [70] on the effects of nutrition education program on dietary behavior and knowledge showed an increase in nutrition knowledge with significant improvement in consumption of dairy products, fruits, and vegetables. An earlier study did not establish any significant effect of nutrition knowledge on the use of food labels among adults [71]. However, in a different study, higher nutrition knowledge was related to the use of food labels [72]. In their review, Spronk and colleagues [73] established

that a third of studies did not find any significant association of nutrition knowledge with food intake of any kind. The same study revealed that association of nutrition knowledge and intake was mostly found in studies that used questionnaires of knowledge or intake that were validated using large sample sizes. Another study [74] concluded that individuals with insufficient nutritional knowledge frequently snack on salty snacks rather than fruits. Also, insufficient nutritional knowledge is related to committing nutritional errors [74].

Reviewing some of the studies that reported using validated questionnaires and reported reliability of the results from items, nutrition knowledge was highly associated with food consumption and healthy behavior [75, 76]. For example, it was established that general nutrition knowledge was associated with healthy eating and persisted after controlling for the demographic variables. Individuals in highest nutrition knowledge quartile were 25 times more likely to meet the recommendations on guidelines for fruits and vegetables and fat intake compared to those in the lowest nutrition knowledge quartile [76]. Another study [75] that used the protection motivation theory in Uganda found a significant effect of the knowledge about salt iodization of parents on other behavioral constructs such as motivation intention and coping appraisals to adopt biofortified legumes in schools. On the other hand, a study that investigated the association between nutrition knowledge and use of products with health claims revealed that the level of nutrition knowledge did not have a significant impact on their behavior towards products carrying health claims [77]. Another investigation aimed to determine whether nutrition knowledge of iron is related to dietary iron intake in young women, and subsequently whether higher knowledge and intake results in better iron status [78]. Authors found a positive correlation between high nutrition knowledge scores and iron intake, however, these were not predictive of achieving the daily dietary recommendation for iron. Finally, a low to moderate association between nutrition knowledge and physical fitness was found among semi-professional sports personalities [79].

Nutrition knowledge to influence behavior among head teachers and extension workers

During the review of the literature, the author found that studies directly investigating nutrition knowledge of school administrators or head teachers and extension workers were not available. Data for teachers was obtained to represent these groups because of similar different demographic characteristics such as age-group, gender, and education. A recent study showed that

only 3% of teachers could answer nutrition knowledge questions correctly [80], yet another revealed that none of the teachers had adequate knowledge on school health program [81]. Almost all teachers in private schools (93%) compared to those in public schools (48%) had poor knowledge about a school health program. A study that investigated the association between nutrition knowledge of teachers and teaching nutrition among elementary school children revealed that those with high nutrition knowledge were more likely to teach nutrition in their classes [82]. In a study that evaluated the effectiveness of the Multicomponent Nutrition Education Program to improve nutrition-related knowledge and behavior in fourth graders, teachers' nutrition knowledge was related to fidelity and completeness of the Nutrition Education Program [83]. Teachers' nutrition knowledge also predicted self-efficacy to teach health practices to children in school [84]. Additionally, a small association of nutrition knowledge and attitudes towards teaching nutrition in classes of elementary school was observed [85]. Nutrition knowledge has been related to better demographic characteristics such as education achievement, gender, marital status, the number of children, and social economic status [86,87].

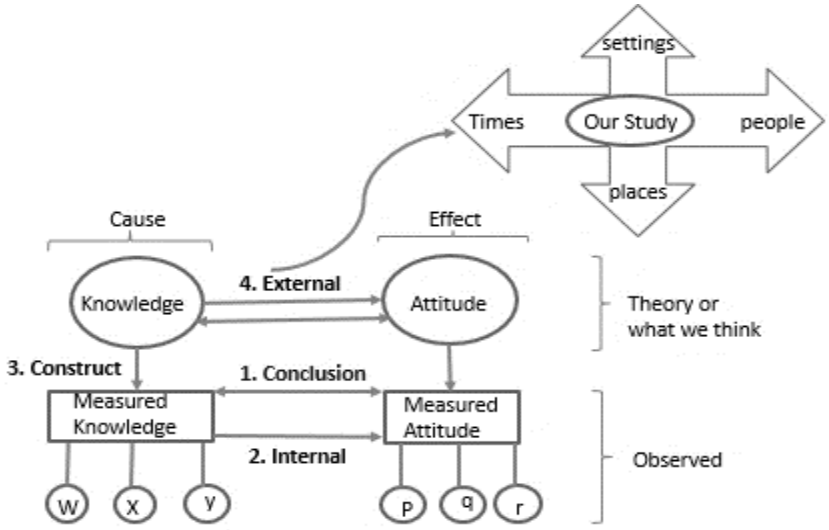
Lack of nutrition knowledge data for head teachers or school administrators and extension workers using validated questionnaires and items in Uganda and other areas is a clear gap. Before nutrition knowledge could be obtained, validation of the general nutrition knowledge questionnaire following systematic steps is critically needed.

2.7 Survey Instruments: Validity and Reliability

Poor measures provide a weak foundation for research and clinical endeavors. Therefore, asserting the validity and reliability of diagnostics and survey instruments is crucial. Validity refers to "the degree to which evidence and theory support the interpretations of test scores entailed by the proposed uses of tests." In other words, validity describes how well one can legitimately trust the results of a test as interpreted for a specific purpose [88]. Validity is not a property of the instrument, but of the instrument's scores, inference and their interpretations. Often, the term "validated questionnaire" is misused in the literature to refer to results of the items by using the questionnaire. i.e. Using "validated questionnaire" is wrong as it implies a dichotomy i.e. validated or not validated, which is not true.

There are four major types of validity as illustrated in Fig. 2.5. *Conclusion validity* answers the question whether there is any relationship between the two variables. One can conclude

whether there is or not a relationship. *Internal validity* seeks to answer whether the relationship between the variables is causal. For example, a claim that knowledge caused a change in attitudes. *Construct validity* seeks to answer whether the measures can be generalized to the theoretical construct (e.g. nutrition knowledge). *External validity* seeks to answer whether conclusions in one study can be generalized to other persons, places, time, and settings [89]. It is difficult to measure abstract constructs such as knowledge, which is a collection of intangible concepts and principles. Most times the validation process seeks to determine the construct validity of the results by using the items in the draft questionnaire.



w, x, y, and p, r, s are items for measured knowledge and attitudes respectively

Fig. 2.5. Illustration of the different types of validity (1 to 4) [89].

Reliability and validity are separate psychometric properties of measuring instruments. Reliability and validity are a continuum i.e. the greater the evidence in the data collected by the measure, and is not plausible to claim that the tool is completely valid or reliable [90]. *Reliability* is the extent to which a measure yields the same number or score each time it is administered when the construct being measured has not changed [90]. The sources of reliability are internal consistency, temporal stability, parallel reliability, and generalizability [88].

Internal consistency is how items measure a similar construct. Split half, Cronbach alpha and Kuder-Richardson formula- 20 are the major mathematical measures used to assess internal consistency [88]. Split half is a correlation between scores on the first and second halves of a given instrument. This measure is rarely used because the "effective" instrument is just half of the

original instrument, therefore, the Spearman-Brown-formula adjusts the value of split half. Kuder-Richardson formula-20 is like the split half measure, however, it takes account of all items and assumes all items are equivalent and very useful on dichotomized data. Cronbach alpha by mathematical definition is an adjusted proportion of total variance of the item scores explained by the sum of covariances between item scores, and thus ranges between 0 and 1 if all covariance elements are non-negative [91]. i.e. $\frac{n}{n-1}$ (1- $(\sum_{i=1}^{n} {\delta_i}^2)/ {\delta_T}^2$), where *n* is the number of items used for the total scale, ${\delta_i}^2$represents the variance of item *i*, ${\delta_T}^2$is the variance of the total scale composite. Cronbach alpha is the most widely used measure of internal consistency. The number of items, the difficulty of items and the sample size affect internal consistency [92]. Acceptable values of Cronbach alpha range from 0.7 to 0.95 [92].

Temporal stability argues that the measurement is reliable when it can elicit similar results over time. Test-retest reliability is a measure of temporal stability of items. It can be understood as relative and absolute reliability. Relative reliability estimates concern with the consistency or association of position of individuals in a group, relative to others. Pearson's Product Moment Correlation coefficient (Pearson's *r*) and the intra-class correlation coefficient (ICC) are the most commonly used relative reliability indices [93]. The main weakness of using Pearson's correlation coefficient is that it does not detect the systematic error [94]. It is also a measure of linear association and not agreement between scores, and therefore, not a good measure of stability [93]. The ICC is computed from the analysis of variables as the variability due to subjects over the total variability. One of the challenges with ICC is that the method of determination is not adequately reported in reliability literature [93,94] and few in nutrition knowledge literature [95]. The ICC has three nomenclatures labeled 1, 2, and 3 from which models are obtained [94]. Models are obtained in one of the two ways, i.e. if scores in the analysis are from single scores from each subject for each trial then we shall have ICC model reported like $ICC_{1,1}$, $ICC_{2,1}$ and $ICC_{3,1}$ respectively. If the scores in the analysis represent the average of the k scores from each subject then we shall the ICC model like $ICC_{1,k}$, $ICC_{2,k}$ and $ICC_{3,k}$, respectively. Studies [93, 94, 96] that have obtained test-retest reliability have mainly used $ICC_{2,1}$ random. Random implies that effects in which all levels of the factor of interest (in this case trials) are included in the analysis and with an attempt of generalization of the reliability of the data beyond the confines of the study [94]. If the study attempts not to generalize then fixed effects are used. *Absolute reliability* is concerned with the variability due to random error. Generally, it seeks to quantify the measurement error

obtained by using the instrument. A *reproducible coefficient* is used to measure absolute reliability and defined as a value below which the absolute differences between two measurements would lie within a 0.95 probability. It is calculated by multiplying the standard error of measurement (SEM) by 2.77 (√2 x 1.96) [93].

Parallel reliability seeks to answer the question whether versions of the same measure produces the same results [88]. It involves administering items from a questionnaire which are modified to some extent and administered to the same individual at same or different times and check if used yields similar results. Quantified using Pearson's *r*.

Agreement reliability involves answering the question who does the rating, and are the scores of the raters similar [88]. Examples of measures used for agreement reliability are percentage agreement among raters, reliability coefficients like Phi, Kappa, Kendall's tau and Intraclass correlation coefficient (ICC). Percentage agreement and Phi do not account for agreement that occurs by chance. In agreement analysis, we seek to answer the question where the raters are certain of their decisions and not guessing [97]. Kappa is the widely-used statistic of interrater agreement reliability [98, 99]. Kappa is defined as;

$$\kappa = \frac{p - e(\kappa)}{1 - e(\kappa)}$$

where, p is the overall percent agreement, and $e(\kappa)$ is the chance agreement [99].

Another new measure of agreement is the Gwet's AC1. Both statistics use the above equation, however, the difference is in the computation of chance agreement [99]. Apart for accounting for agreement by chance like the Kappa, Kendall's tau, or ICC, Gwet's AC1 was shown to provide a more stable inter-rater reliability coefficient and less affected by prevalence and marginal probability than that of Cohen's Kappa [99]. The low values of Kappa with high agreement prevalence have been termed as "Kappa Paradox" [98, 99]. The second paradox, the level of disagreement among the raters may lead to high Kappa [98]. There is a tendency of obtaining high Kappa with an asymmetrical imbalance of marginal totals than the symmetrical imbalance. There is an improved version of Kappa (Adjusted Kappa), however both problems are not completely solved [99].

Generalization theory provides a unifying framework for the various reliability measures [88]. It deals with how much each factor involved in the measurement process (e.g. item, item

grouping, subject, rater, and day of administration) contributes to the measurement error. Unreliable scores can be attributed to the mentioned factors. Analysis of variance is used to quantify the contribution of each error source to the overall error.

Validation process for survey instruments

Development and validation of questionnaires undergo three major phases: i) item development and identification of domains, ii) cognitive debriefing using a small sample size, and iii) psychometric validation [100]. The process of development and validation of general nutrition knowledge questionnaire has specifically taken a similar framework in the previous studies [68, 95, 101, 102, 103]. These studies specifically start with a literature review to identify questionnaires and items that evaluated nutrition knowledge for similar populations and that have reported psychometric evaluation (content, face and construct validity and reliability) (Fig. 2.6). Based on the context, authors decide on the items to adapt basing on the quality of the psychometric results of previous studies [68, 95, 102]. The selected questionnaire is administered to a panel of experts in nutrition and related fields such as dietetics, education, health, psychology, and agriculture [68, 103, 104]. The expert panel revision leads to improved clarity and content in terms of the appropriateness and cognitive complexity of the items [105]. After obtaining the first draft, validation continues with survey pilots in a sample of the target population. Previous studies have used internal consistency (e.g., using Cronbach alpha as an indicator) and test-retest reliability (e.g., using correlation coefficient and ICC) as measures of the reliability of nutrition knowledge questionnaires [68, 95, 102].

In case there is no questionnaire for the target population and nutrition knowledge, a literature review is done to obtain a pool of items and topics (Fig. 2.6). The topics and items should suit the target population and the purpose of the study. Focus group discussions with experts and qualitative studies are normally used to generate more items and align with study area [100]. The respondents are asked if there any other aspects of nutrition that can be evaluated. Expert panels then evaluate all the items in the pool on whether they are relevant and can evaluate nutrition knowledge [101]. Agreement among panel members is imperative. Similar as before, it is recommended to administer the questionnaire to a small group of the target population and query about the questionnaire's comprehensiveness, relevance, and clarity of expression. After this step, the questionnaire undergoes psychometric validation (i.e., construct validity, internal consistency,

and test-retest reliability). Before the reliability of items is obtained, item difficulty and discrimination are obtained. Item discrimination is the ability of the item to discriminate between high and low performers [104]. It is obtained using item-to-total correlation coefficient. It is a ratio of item loading to the residual variance. It represents a ratio of the amount of information the item shares with knowledge (answers) to what it does not.

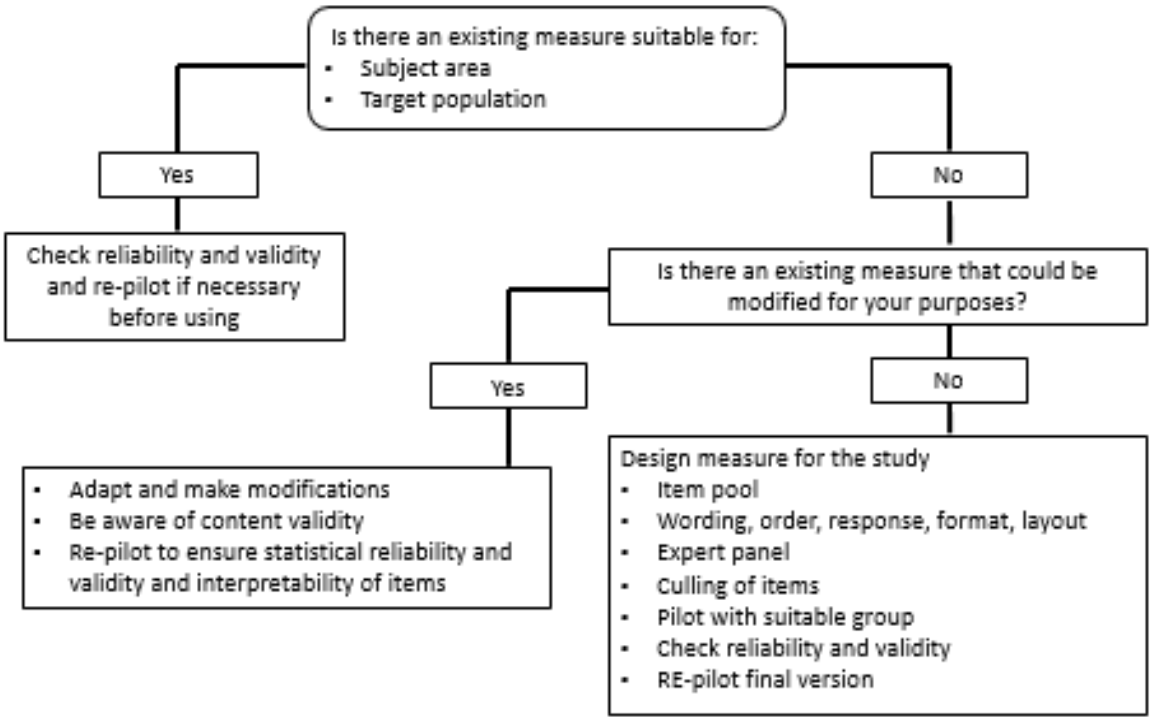


Fig. 2.6. Steps for developing and validating a questionnaire [101].

Construct validity sub-types

Construct validity refers to the degree to which inferences can legitimately be made from the operationalization of the study to the theoretical construct on which those operationalizations are based [89]. In this study, measurement of construct validity seeks to answer the extent to which the GNKQ measures nutrition knowledge of head teachers in Uganda. Construct validity is understood in two dimensions, translational and criterion-related validity (Fig. 2.7).

Translational validity is given the name to help summarize both content and face validity [89,106]. Translational validity is the degree to which a construct (i.e., nutrition knowledge) is

accurately translated into operationalization. Within this dimension, content validity aims at inquiring from experts in the specific field (e.g., nutrition) and those related to the studied field (e.g., agriculture, health, and education), and from the available literature the relevance of the domains used to describe the construct (nutrition knowledge) during the functioning and operating reality. It is recommended to use at least three experts during content validity [97]. *Face* validity seeks to look at the operationalization and see whether on its face it seems like a good translation of the construct [89]. Previous studies [95, 102, 104] on development and validation of nutrition knowledge questionnaire qualitatively determined content and face validity, however, did not provide quantitative evidence of achieving adequate validity benchmarks. Thus, it is recommended to report both qualitative and quantitative outcomes on content validity [106].

Criterion-related validity pertains to evidence of the relationship between the items in the questionnaire and their performance on another independent measure of nutrition knowledge. In criterion-related validity, the questionnaire developer examines whether the functioning and operating reality of the construct (nutrition knowledge) behaves in the way it should, given the theory of the construct [89, 106]. Criterion validity is divided into four types: predictive, convergent, discriminant and concurrent validity (Fig. 2.7). *Concurrent* validity is the ability of the questionnaire content to distinguish among those people with known (at least theoretically) differences in knowledge, e.g., experts vs. non-experts. *Convergent* validity is the extent to which different items of the same construct correlate with each other. *Discriminant* validity is the extent to which items of the different constructs do not correlate with each other. *Predictive* validity is the ability of the scores obtained from the questionnaire to predict ideal outcomes expected under study [89].

Factors that influence psychometric measures

There are many factors that may affect the psychometric properties of instruments including population characteristics, cross-cultural applications, recall bias and instrument administration formats. *Population characteristics* such as age, gender, race and ethnicity, marital status, socioeconomic status, and education among others are known to affect psychometric properties of survey instruments [87, 95]. To avoid these effects, it is recommended to use: i) available item banks from previously validated questionnaires measuring a single domain, ii) use items adjusted to suit the target population, and iii) use shorter versions of the questionnaires to

avoid response burden [90]. *Cross-cultural application* relates to the use of items across multiple cultures. Items may be developed from a single institution or country and may not have tested elsewhere. Therefore, such items may not be generalizable and thus require validation [90]. The *recall period* used to test an instrument, if not well conceived depending on the concept under study, may cause bias and affect the test-retest reliability [90]. *Variations in the instrument administration* such as mode of administration, the timing of assessment and differences between proxy reports and self -reports data are also important to consider. Proxy data may lead to higher performance than the self-report data especially when administering cognitive scales such as nutrition knowledge [90]. Ideally, an instrument should be re-evaluated when any changes or adaptations occur. Nonetheless, due to time burden and budgetary constraints, this might not be feasible.

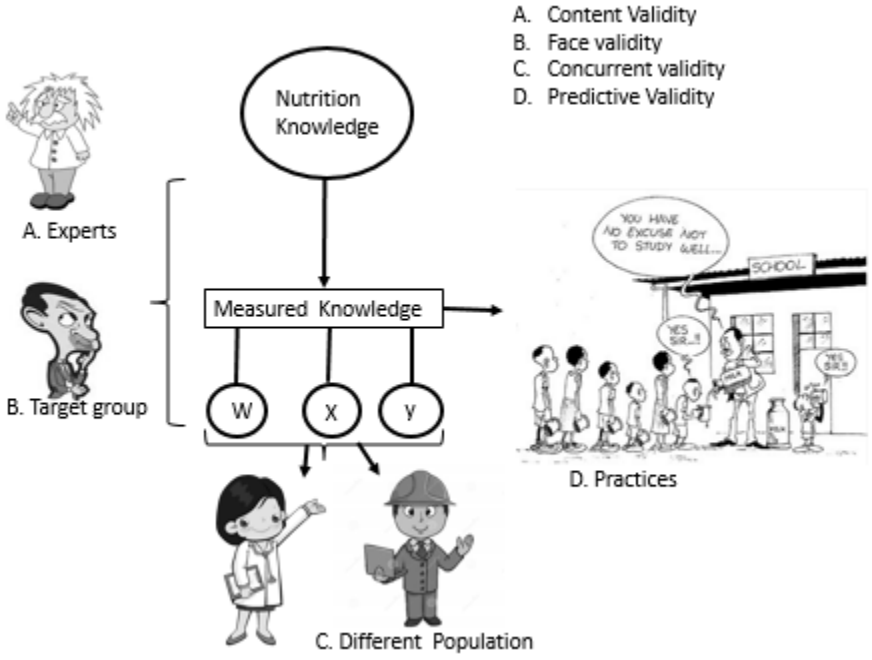


Fig. 2.7. Illustration of subcategories of construct validity. Adapted from [89].

Qualitative approaches to strengthen the validation process

Focus groups can be used to elicit information about important issues and concerns about survey instruments [90]. This may uncover cultural differences in the experiences of the domains used in the questionnaire. Focus groups can produce feedback on item formulation and

interpretation of the items. When evaluating lengthy questionnaires, focus group members fill them in advance, and during the discussions they are asked to identify complex terms and unclear items. Focus groups bring out explanations for interpreting collected data [90].

The cognitive interview process includes both the administration of an instrument and the collection of additional verbal information about the questionnaire responses [90]. Cognitive interviews help understand the underlying process involved in responding to questionnaire items using verbal probing techniques. They help to evaluate the quality of each item regarding a person's understanding of the item, ability to retrieve the appropriate information, decision-making on reporting retrieved information, and selection of the response. Cognitive interviews can be used to examine relationships between participant characteristics and questionnaire items. In general, 5-12 subjects are recommended for cognitive interviews [90].

Benchmarks for commonly used psychometric measures on nutrition knowledge questionnaire validation

There are different statistics that have been used for the various psychometric measures as summarized in Table 2.1. *Content validity* is determined both qualitatively and quantitatively. Only one study [103] on validation of nutrition knowledge questionnaire has quantitatively reported the agreement proportion and reliability on content included in the draft questionnaire. Acceptable percent agreement on item and scale are 0.79 and 0.89, respectively, and it depends on the number of experts in the panel [97]. Gwet's AC1 was used in that study where, AC1 < 0.4 was poor, 0.4-0.75 was intermediate to good, and above 0.75 was excellent as recommended in another study [99]. Agreement proportion of one for *face validity* can be used where all participants agree during the focus group discussions [103]. Acceptable *item difficulty* of 10-90% [68, 103], 20-90% [102] and 20-80% [104]; correct points have been reported in the validation of nutrition knowledge questionnaires. For *item discrimination*, most studies [68, 95, 102- 104] validating nutrition knowledge questionnaires have used item-to-total-correlation coefficient of less than 0.2 to qualify unacceptable items. All studies on the validation of nutrition knowledge have used Cronbach alpha greater than 0.7 as the acceptable *internal consistency* for domains or scale. Authors in other disciplines [92] have recommended internal consistency at α of 0.7-0.95 as acceptable, below which represents the existence of items with poor reliability due to a low number of items and poor item difficulty. Higher values of internal consistent, Cronbach $\alpha > 0.9$ represent redundancy in the

items comprising specific domains, suggesting the need to shorten the questionnaire. *Test-retest* reliability has been evaluated using Pearson's correlation [102, 104] or Spearman's rank correlation coefficients [103] for parametric and non-parametric data, respectively. One study [95] on evaluation of reliability of nutrition knowledge data reported using Intra-class Correlation Coefficient (ICC), however authors did not report the type of ICC used. In addition, the same study [95] on validation of nutrition knowledge questionnaire reported adequate test-retest reliability using paired *t*-test on test-retest scores. The test-retest scores should not be significantly different ($p > 0.05$) [93]. A test of no mean difference is a measure of the absence of bias [93]. Other studies [93, 94] recommend reporting at least two measures of test-retest reliability. *Construct validity* has been evaluated using mean separation techniques (*t*-test, analysis of variance (ANOVA), and Mann-Whitney U for non-parametric data) on scores of populations hypothetically known to be different [68, 95, 103, 104]. Knowledge scores using the validated questionnaire have been used to predict nutrient consumption [76]. This constitutes predictive validity, for which correlation and regression analysis are often employed. Therefore, it is recommended that the survey designer understands the above validation measures before choosing questionnaire items to adapt [101].

Table 2.1. Summary of statistics and benchmarks for validation measures

Measure	Statistic	Benchmark
Content validity	Percent agreement on item Percent agreement on scale	0.79 for item and 0.89 for the whole scale based on number of experts
	Kappa (κ) and Gwet's AC1	κ/ AC1< 0.4- poor; 0.4-0.75 -intermediate to good; >0.75- excellent.
Face validity	Percent agreement on item	1 on item and scale
Item difficulty	Percent of correct answers	0.1-0.9; depends on investigator
Item discrimination	Item to total correlation	$r \geq 0.2$
Internal consistency	Cronbach alpha Kuder-Richardson formula- 20	Acceptable $\alpha = 0.7$-0.95
Test-retest reliability	Pearson correlation ICC	r/ ICC ≥ 0.7
	Paired *t*-test	$p > 0.05$
Construct validity	Separation of means using: • *t*-test • ANOVA • Mann-Whitney U	$p < 0.05$ for hypothetically different populations
Predictive validity	Correlation Regression	$p < 0.05$ for r and β

2.8 Study Areas and Characteristics

Uganda. It is a landlocked country located in East Africa. It has a total land surface area of 241,039 square kilometers [107]. It is bordered by Sudan to the north, Kenya to the east, Tanzania to the south, Rwanda to the southwest and the Democratic Republic of Congo to the west. Uganda lies between 1000 to 3000 m above sea level. Uganda is located in East Africa and lies across the equator, about 800 kilometres inland from the Indian Ocean. It lies between 10 29' South and 40 12' North latitude, 290 34 East and 350 0' East longitude.. Uganda has a total population of 34 million [11]. It has a central government with the president as the highest authority. The central government provides policy guidelines to the lower administrative units including the districts (n =112), sub-counties, and villages or wards (Fig. 2.8).

Kampala. It is the capital city and is found in the Central Region of Uganda. It is bordered by Wakiso District in the West, Mukono district in the East and Lake Victoria in the south. The city has a population of over 1,500,000 dwellers [11]. The City is comprised of five administrative divisions namely Kampala Central, Kawempe, Nakawa, Makindye, and Lubaga Divisions. There are over 466 primary schools in Kampala of which 83 and 383 are public and private institutions, respectively. The total enrollment in primary schools is over 175,865 children [9].

Mukono. Mukono District is found in the Central Region of Uganda. It lies on the coordinates of 00°20′N 32°45′E. Mukono District is bordered by Kayunga District in the north, Buikwe District in the east, Kalangala District to the southwest, Wakiso District and Luweero District to the northwest and Tanzania to the south. The population is 599,817 people [11]. The District comprises of three administrative units, Mukono County, the Mukono Municipal Council, and the Nakifuma County. The District has over 212 government aided and 126 private primary schools making a total of over 338 schools [9]. The coordination of education activities is under the District Education Office. The total primary school enrollment is over 127,560 pupils.

Wakiso. Wakiso is the District that almost encircles Kampala district. The district lies on the coordinates of 00°24′N 32°29′E. The district is bordered by Nakaseke District and Luweero District to the north, Mukono District to the east, Kalangala District in Lake Victoria to the south, Mpigi District to the southwest and Mityana District to the northwest. Wakiso has a total population of about two million, making it the most populous district in Uganda [11] . Strikingly, 53% of the population consist of children below 18 years. This district is rapidly urbanizing due to its location. Wakiso is made up of two counties and one municipality. The district is further

subdivided into 15 administrative units called sub counties or town councils. The district has over 268 government aided and 415 private aided primary schools making a total of over 683 schools. [9] The total primary school enrollment is over 204,000 pupils making it the district with the highest enrollment in Uganda.

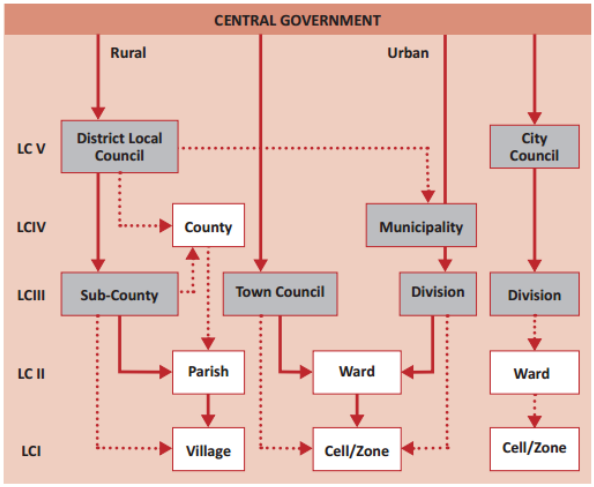


Fig. 2.8. Administrative structures in Uganda [108].

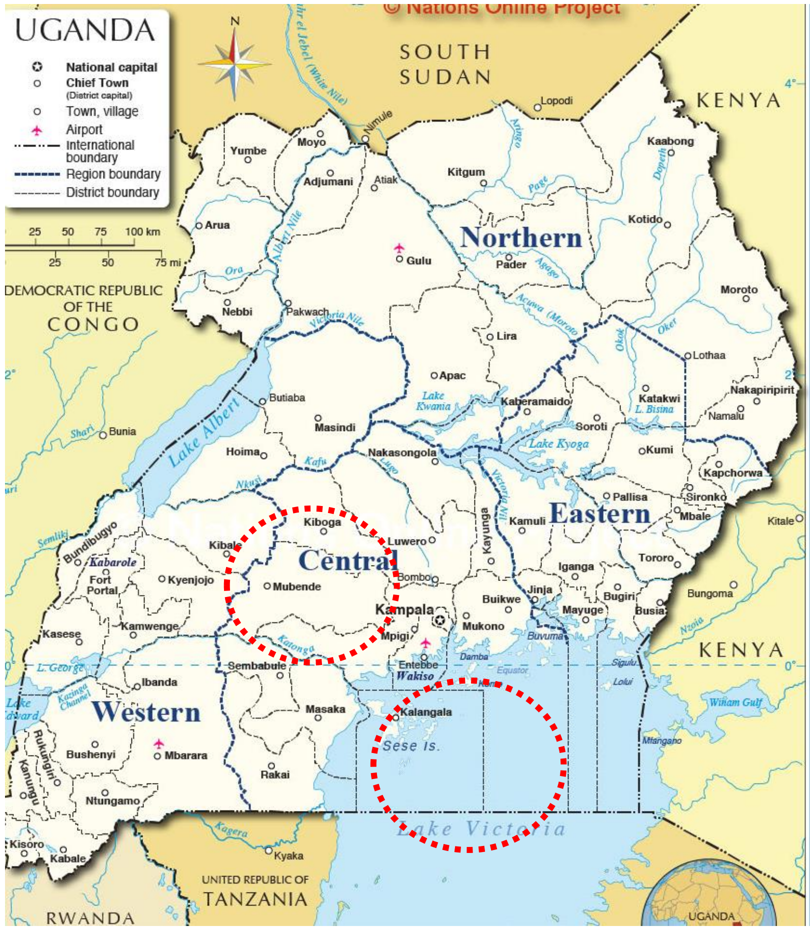


Fig. 2.9. Map of Uganda indicating the study areas circled with red dots [109].

Makerere University, Kampala. It is located on Makerere Hill, one of the many hills comprising Kampala City. The main Campus is about 5 km to the North of Kampala City Center covering an area of 300 acres. Makerere University is among the ten oldest Universities in Africa that was established in 1922 as a technical school, with 14 students studying Carpentry, Building, and Mechanics [110]. Later various courses such as Medical Care, Agriculture, Veterinary Sciences and Teacher Training were offered. The University has evolved into ten colleges and one School offering Law. The University has a population of over 35,000 undergraduate and 3,000 graduate students. In this study, the author recruited students from two colleges, the College of Agriculture and Environmental Sciences (CAES) and the College of Engineering, Design, Art and Technology (CEDAT).

The CAES has three schools among which is the School of Food Technology, Nutrition, and Bio-Systems Engineering (FTNB). The School of FTNB accommodates three departments

including the Department of Food Technology and Human Nutrition from which the author recruited third-year Nutrition students. The College of Engineering, Design, Art and Technology (CEDAT) has three schools with three departments each. The CEDAT has a total enrollment of over 2,892 undergraduates and 110 graduates students. There are 110 students enrolled in the third and fourth year of the Mechanical Engineering program, some of which were subjects for this study.

Kiboga and Kyankwanzi. Kiboga district is predominantly a rural district that was formed in 1991. The district is bordered by Nakaseke District to the northeast and east, Mityana District to the south, Mubende District to the southeast, and Kyankwanzi District to the northwest. In 2010, the district was split into two, the western part being set up as a separate district, Kyankwanzi District. Kiboga East County is the only county in the district. Kiboga has a total population of 148,606 and Kyankwanzi, 214,057 [11]. Over 70% of the populations in these districts live in rural areas.

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CHAPTER 3: VALIDITY AND RELIABILITY OF DRAFT GENERAL NUTRITION KNOWLEDGE QUESTIONNAIRE FOR ADULTS IN UGANDA

Abstract

This study sought to develop and validate a general nutrition knowledge questionnaire (GNKQ) for Ugandan adults. The initial draft consisted of 133 items on five knowledge domains associated with nutrition knowledge including *Expert recommendations* (16 items), *Food groups* (70 items), *Selecting food* (10 items), *Relationship of nutrition and disease* (23 items), and *Food fortification* in Uganda (14 items). The questionnaire validity was evaluated in three studies. For the content validity (study 1), a panel of five content matter nutrition experts reviewed the GNKQ draft before and after face validity. For the face validity (study 2), head teachers and health workers (n = 27) completed the questionnaire before attending one of three focus groups to review the clarity of the items. For the construct and test-rest reliability (study 3), head teachers (n = 40) from private and public primary schools and nutrition (n = 52) and engineering (n = 49) students from Makerere University took the questionnaire twice (two weeks apart). Experts agreed (content validity index, CVI > 0.9; reliability, Gwet's AC1 > 0.85) that all constructs were relevant to evaluate nutrition knowledge. After the focus groups, 29 items were identified as unclear, requiring major (n = 5) and minor (n = 24) reviews. The final questionnaire had acceptable internal consistency (Cronbach $\alpha > 0.95$), test-retest reliability (r = 0.89), and differentiated ($p < 0.001$) nutrition knowledge scores between nutrition (67 ± 5) and engineering (39 ± 11) students. Only the construct on nutrition recommendations was unreliable (Cronbach $\alpha = 0.51$, test-retest r = 0.55), which requires further optimization. The final questionnaire included topics on *Food groups* (41 items), *Selecting food* (2 items), *Relationship of nutrition and disease* (14 items), and *Food fortification* (22 items) and had good content, construct, and test-retest reliability to evaluate nutrition knowledge among Ugandan adults.

3.1 Introduction

Malnutrition among school-aged children in Uganda remains high [1,2] as 22%–38% are considered stunted, 38% are anemic, and 80% are iron-deficient, undermining national education efforts. This is partly due to poor feeding practices at homes and at schools [3]. Approximately 40% of the schools do not provide meals; 92% of rural children go to school without breakfast and 70% do not eat lunch at school. Additionally, few schools provide fruits, vegetables, animal source, and fortified food that can reduce micronutrient deficiencies [3]. Poor nutrition status manifests from the complex interaction of biological, intra- and interpersonal, and environmental factors that determine food choices and consumption among children [4]. At schools, head teachers' actions are among the many interpersonal factors that can influence the school environment for children and, potentially, for their parents and other teachers. Head teachers are centrally positioned to promote nutrition in schools and their communities, often supporting nutrition interventions led by government and development partners [5,6]. Nonetheless, the ability of teachers and heads to influence healthy behaviors at schools might be limited by their knowledge of and attitudes towards nutrition [7].

The determinants of diet-related behaviors include biologically determined behavioral predispositions, experience with foods (physiological and social conditioning), intra- and interpersonal factors, and environmental factors [4]. Knowledge is a key determinant of behavior, categorized within inter- and intrapersonal factors [4] and included within several theoretical frameworks such as the Social Ecological Model and the Social Cognitive Theory [8–11]. Increased nutrition knowledge has been associated with improved dietary habits and lower rates of obesity [12–14]. Furthermore, prior evidence indicates that gender differences in nutrition knowledge may explain differences in unhealthy behaviors, such as overeating and smoking habits [15,16]. These studies suggest that monitoring and evaluating nutrition knowledge using valid instruments is an important component of health and nutrition education.

In Uganda, most studies have focused on evaluating knowledge, attitudes, and practices associated with nutrition in vulnerable populations, e.g. people with HIV-AIDS, infants, and young children [17,18]. These studies, however, have inadequately evaluated nutrition knowledge. The issue stems from two major factors; disagreement on a definition of nutrition knowledge and the use of instruments that are not validated [17,18]. Nutrition knowledge is defined as the understanding of basic facts about food and nutrition [19–22]. At a very basic level, nutrition

knowledge should be defined by at least two of the following concepts during evaluation; food groups, balanced diets, current dietary guidelines, sources of nutrients, storage, and preparation of food, use of food labels, and the relationship between nutrition and disease [19–24]. Most studies evaluating indicators of nutrition, including knowledge, in Uganda often adapt questionnaires from elsewhere, which do not undergo the complete validation process [17,18]. The lack of validated instruments negatively affects the quality of the resulting data and its extrapolation to a wider population, as well as limiting the ability to compare results from different studies [25]. Additionally, not validating survey tools reduces the ability of any given study to detect associations with other modulating factors, specifically feeding behaviors [25]. Thus, the use of low-quality data could negatively impact policies and programs and the effective use of resources. In Uganda, this was identified as a major gap to scaling up public nutrition action [26].

In order to support future nutrition education interventions in Uganda, this study sought to validate a general nutrition knowledge questionnaire (GNKQ) for adults using a systematic approach, involving college students and head teachers.

3.2 Aims of this Chapter

AIM 1: Determine the content and face validity of the GNKQ to evaluate nutrition knowledge of head teachers in Uganda. For evaluation of content validity, a panel of experts (n = 5) in the fields related to nutrition (agriculture, education, health and nutrition) evaluated a set of nutrition knowledge dimensions of the initial draft of the GNKQ twice. Face validity was attained by administering the second draft of the GNKQ to a group of head teachers and health workers individually (n =27) and conducting focus groups (n =3 groups) with the same individuals. The results helped to obtain the third draft of the GNKQ that was used to evaluate knowledge among adults (head teachers and later extension agents) in Uganda.

AIM 2: Determine the construct (concurrent) validity, internal consistency, and test-retest reliability of the items of the nutrition knowledge questionnaire. To determine construct validity and test-retest reliability, the third draft of the GNKQ was administered to two population groups, college students (nutrition n = 40; engineering n = 37) and head teachers from schools in Kampala (government n = 23; private n = 17) in two occasions separated by two weeks. Experts in AIM 1 were consulted again after obtaining results to discuss the elimination of specific items and/or nutrition dimensions.

3.3 Methods

Review of Existing Nutrition Knowledge Questionnaires

A literature search in PubMed, Web of Science, and EBSCO using the keywords 'nutrition' AND 'knowledge' AND 'validation' between 1 January 1999 and 31 November 2014 revealed 154, 127, and 97 studies that evaluated nutrition knowledge, respectively. Studies were excluded if they did not focus on adults, were disease-focused questionnaires, were literature reviews, or did not provide validation of any type. Based on the review of titles and abstracts, validated questionnaires of nine studies were included (Table 3.1) [19–23,27–32]. These studies were mainly from Europe, North America, Australia, and Africa. The questionnaire from Parmenter and Wardle (1999) [19] was selected because of its: (a) widespread application to build similar questionnaires in several regions including Sub-Saharan Africa [20,31]; (b) reported validity and reliability; (c) inclusion of more than two domains of nutrition knowledge; and (d) target population.

Table 3.1. Studies selected in the final review to draft the initial general nutrition knowledge questionnaire (GNKQ) for adults in Uganda.

Region/ Country	Ref.	Year	Target Group	No. of Topics on Nutrition	Were Validation Steps Reported during the Psychometric Tool Development? (Yes/No)				
					Content Validity	Face Validity	Internal Consistency	Construct Validity	Test-Retest Reliability
Uganda	[17]	2010	Adults	4	No	No	No	No	No
	[18]	2005	Adults	1	No	No	No	No	No
	[33]	2015	Adults	1	No	No	No	No	No
Sub-Saharan Africa	[20]	2005	Youth	5	Yes	Yes	Yes	Yes	No
	[31]	2008	Adults	1	Yes	Yes	Yes	Yes	No
Americas	[23]	1997	Adults	2	Yes	No	Yes	Yes	No
	[29]	2003	Adults	2	Yes	Yes	Yes	Yes	Yes
	[32]	2009	Adults	6	Yes	Yes	Yes	No	No
Europe	[19]	1999	Adults	4	Yes	No	Yes	Yes	Yes
	[27]	2012	Adults	4	Yes	Yes	Yes	Yes	Yes
	[30]	2013	Adults	2	Yes	Yes	Yes	Yes	Yes
Australia	[28]	2008	Adults	4	Yes	Yes	Yes	Yes	Yes

Validation of the GNKQ followed steps described in a previous study [24] and procedures from other studies [20,21]. The selected questionnaire [19] had four constructs (110 items) evaluating nutrition knowledge: (i) *Expert recommendations* (11); (ii) *Food groups* (69); (iii) *Selecting food* (10); and (iv) *Relationship of nutrition and disease* (20). Food composition tables for Uganda [34] and Tanzania [35] were used to modify the GNKQ draft (Appendix 1). Items on

food fortification were adapted from a study in Uganda [36]. Currently, the Ugandan government and developing partners are promoting fortification [3,26]. Items on sources of nutrition information and demographic characteristics were included from another study [19,20].

Ethical Approval

The Institutional Review Board at the University of Illinois (IRB#15469) and the Uganda National Council for Science and Technology (No. SS 3700) approved all research protocols. The Ministry of Health, District Education Offices, and Department Heads at Makerere University provided permissions to conduct studies. All subjects provided consent before participation.

Assessment of content validity

Subjects. An expert panel reviewed the content of the initial GNKQ draft. Contact information for the experts was obtained from the Nutrition Unit at the Ministry of Health, Kampala Uganda. Fifteen experts received the consent form along with the questionnaire electronically via Qualtrics Survey Software (2015; Qualtrics, Provo, UT, USA) [37]. Experts had over five years of work experience and knowledge of nutrition policies and programs in Uganda. Only five experts in the fields of health education (1), nutrition (2), agriculture (1), and education (1) completed the GNKQ. This number of experts was considered sufficient to review the instrument based on results from previous survey design studies, which used three to five experts to evaluate content validity [38,39].

Procedures and analyses. Experts reviewed and rated each item on its relevance, clarity, simplicity, and ambiguity to evaluate nutrition knowledge using a four-point Likert scale (1–4), representing low to high agreement. For content validity, the items under review included the question statement and its answer options. Expert reviews took at least two weeks to a month and were conducted twice, before and after face validation (Study 2). Scores on relevance were used to generate a content validity index, while clarity, simplicity, and ambiguity were used to pinpoint disagreement in the questionnaire's structure. Also, experts recommended items to add/delete based on language, food, and nutrition policies in Uganda (Table 3.2). Scores evaluating the relevance of 'items' were dichotomized as explained in another study [40]. Levels '1' and '2' were assigned '0', while '3' and '4' were assigned '1'. The content validity index

(CVI) was the number of experts answering '3' or '4' (in agreement) divided by the total number of experts. The CVI was determined using Microsoft Excel 2010 (Microsoft, Redmond, Washington, U.S.A). The acceptable CVIs for items and constructs were 0.79 and 0.89, respectively [40]. Inter-rater reliability was determined using Gwet's AC1. The command of 'three raters or more' in AgreeStat2013.3 (Advanced Analytics, LLC, Gaithersburg, MD, USA) [41] was used to estimate Gwet AC1. Benchmarks for Gwet's AC1 were used, in which values <0.4 were poor, 0.4 to 0.75 were intermediate to good, and >0.75 were excellent [42].

Table 3.2. Units of analysis for content validity and reliability analyses.

Topic on General Nutrition	Study 1		Study 3	
	First Draft	After Content and Face Validity	After Content and Face Validity	After difficulty, Discrimination, & Internal Consistency Analysis
	Items (Statements/Answer Options)		Items (Answer Options)	
Expert Recommendations	4/16	4/16	16	0
Food groups	21/70	17/66	66	41
Selecting foods	10/10	10/10	10	2
Relationship of nutrition and disease	10/23	11/24	24	14
Food fortification	3/14	5/23	23	22
Total	48/133	47/139	139	79

Study 2. Assessment of face validity

Subjects. Fifteen head teachers and twelve health workers from Kampala district filled out the modified GNKQ before attending one of three focus groups. Broad guidelines for conducting focus group discussions were used to determine the number and size of the groups [43]. The first two focus groups were comprised of seven (two female and five male) and five (two female and three male) head teachers. The third focus group was conducted with seven health workers (two female and five male), which included four nurses, two clinical officers, and a medical officer.

Procedures and analysis. Subjects reviewed and rated each item (statement and answer options) of the modified GNKQ based on clarity (Yes '1' or No '2') to the target group before attending a focus group. They provided reasons for unclear items. The CVI for items and

constructs was calculated based on the number of participants in agreement (i.e. clarity = 'yes') divided by the total number of respondents [44]. The focus groups were conducted using the available recommendations [45]. Unclear items were reviewed during the focus groups. Each suggested modification was discussed until all participants agreed on clarity and there were no alternative opinions (saturation). Discussions during all focus groups were digitally recorded. Each focus group lasted two hours.

Study 3: Construct validity and test-retest reliability

Subjects. Forty head teachers were recruited from private (52%) and government (48%) sponsored primary schools and from schools with (n = 23) and without (n = 17) a feeding program. The head teachers were adults (18–74 years) of both sexes (43% female). Additionally, second and third-year undergraduate students from the nutrition (n = 52) and engineering (n = 49) departments at Makerere University participated in this study. The students were adults (18–34 years) of both sexes (48% female). Students from other years and departments were excluded.

Procedures. The purpose of the pilot survey was to ascertain internal consistency, test-retest reliability, and construct validity of the items in the modified GNKQ after the second expert review. Students completed the questionnaire online via Qualtrics (2015). Each item was programmed to be a complete entry before moving to the following section or question to avoid missing entries. In this case, if the student did not know about the whole section on fortification, the answers were marked "don't know" and these did not carry any points. Head teachers completed the GNKQ at their schools. The questionnaires from the head teachers were checked for missing data before leaving the field. They were asked to fill any missing information before leaving the field. All subjects completed the same questionnaire after two weeks. The GNKQ consisted of the same five constructs and 139 items (Table 3.2), which represented the maximum score (i.e. 139 points). Before leaving the field, questionnaires were checked to ensure all items had responses. The answers were scored using a procedure previously reported [20], in which right answers were assigned one point and wrong ones or unsure responses with no points. Other sections (i.e. sources of nutrition information and demographics) were not scored. All data were exported to the Statistical Package for Social Sciences (SPSS v23.0, IBM Corporation, Armonk,

New York, U.S.A) for analysis. The indices detailed below were calculated as described elsewhere [19].

Analyses. Data from all subjects were used to ascertain item difficulty, item discrimination, internal consistency, and test-retest reliability but not for construct validity. Item difficulty was evaluated using benchmarks provided earlier [20]. Items are useful if they are answered correctly by 10%–90% of the respondents. Items that did not meet this criterion were removed from the analysis. Item discrimination is the ability for each item to discriminate between people with different levels of knowledge [19,46]. The item to total correlation coefficient, which is a correlation between an item score and the total score of the GNKQ, was obtained to evaluate item discrimination. Items with a coefficient < 0.2 were removed from analysis. Internal consistency refers to the extent to which all items in the scale measure the same attribute. Cronbach alpha (α) was obtained from dichotomised (correct = 1, wrong/ unsure = 0) values using SPSS23. Nutrition knowledge constructs and the whole GNKQ with $\alpha > 0.7$ were considered with adequate internal consistency. Construct validity is the extent to which a test measures the attribute or variable it is intended to measure [19,47]. To ascertain construct validity, two populations with assumed different knowledge are commonly used [24]. Thus, differences in the GNKQ's scores between nutrition vs. engineering students were used to assess construct validity. Differences in nutrition knowledge were evaluated using the Mann-Whitney *U* Test. Test-retest reliability demonstrates that the results produced are consistent over time. Head teachers' and students' scores over the two-week period were used in this estimation. Since the data were not normally distributed, the Spearman Rank correlation coefficient (*r*) was used. The acceptable test-retest reliability was $r \geq 0.7$.

3.4 Results

The GNKQ for Uganda is available in Supplementary Information (Appendix 1).

Study 1: Content validation

The overall CVI on the relevance of items to evaluate nutrition knowledge after the first and second round was 0.89 and 0.97, respectively (Table 3.3). After the first round of expert review, only items on the constructs of 'nutrition and disease relationship' had an acceptable

content validity index (CVI > 0.9). The expert agreement reliability on the relevance of the contents improved (Gwet's AC1 from 0.71 to 0.96) after face validity on the second expert review.

Study 2: Face validation

A total of 29 items from all the constructs were considered unclear (CVI < 1) by the head teachers and health workers. Only five of the 29 items had major changes as reviewed during the focus groups. The participants agreed that other items were clearly understood even though they were unsure of the definite answers. The items that were modified in the focus groups are found in the supplementary materials.

Table 3.3. Content validity index (CVI) and reliability of expert agreements before and after face validation.

Topics (No. of Items after 1st/2nd Review)	First Round			Second Round		
	CVI	**Gwet's AC1**	***p*-Value**	**CVI**	**Gwet's AC1**	***p*-Value**
Expert Recommendations (4/4)	0.85	0.60	<0.05	0.90	0.89	<0.05
Food groups (21/17)	0.88	0.81	<0.05	0.93	0.92	<0.05
Food choices (10, 10)	0.84	0.62	<0.05	1.00	1.00	<0.05
Relationship of nutrition and disease (10/11)	0.96	0.91	<0.05	1.00	1.00	<0.05
Food fortification (3/5)	0.73	0.23	>0.05	0.92	0.91	<0.05
Whole Questionnaire (48/47)	0.89	0.71	<0.05	0.97	0.96	<0.05

Study 3: Internal consistency, test-retest reliability and construct validity

Characteristics of the participants are presented in Table 3.4. The results of internal consistency and test-retest reliability are presented in Table 3.5. For all participants, the internal consistency after the first and second round of surveys and before deleting any items were; knowledge of *Food groups* (α = 0.81 and 0.81), *Relationship of nutrition and disease* (α = 0.77 and 0.84), *Food fortification* (α = 0.94 and 0.93), *Expert recommendations* (α = 0.46 and 0.56), and *Selecting food* (α = 0.40 and 0.38), respectively.

Table 3.4. Characteristics of the participants in the test-retest study.

Characteristic	Nutrition Students (*n* = 40)		Engineering Students (*n* = 37)		Head Teachers (*n* = 40)	
	N	**%**	***n***	**%**	***n***	**%**
Gender						
Male	14	35	26	70.3	23	57
Female	26	65	11	29.7	17	43
Age						
18–24	35	87	33	89		
25–34	5	13	4	11	8	20
35–44					10	25
45–54					15	38
55–64					6	15
65–74					1	2
≥75						
Education						
Ordinary Secondary school					2	5
High School (A' level)					1	2
Technical college					1	2
Diploma					17	43
Degree					14	35
Postgraduate degree					7	13
Number of children						
None	37	92	36	97	2	5
1	2	5	1	3	2	5
2	1	3			8	20
3					5	13
4					9	22
≥5					14	35

After the deletion of items using the criteria of item difficulty and discrimination, *Selecting food* for the first and second round was $\alpha = 0.92$ and $\alpha = 0.84$. However, the entire *Expert recommendations* construct was eliminated during analysis because of unacceptable internal consistency ($\alpha = 0.59$). The test-retest reliability for items in the constructs on *Expert recommendations* and *Selecting food* were unacceptable ($r < 0.7$) before deleting the items with unacceptable item difficulty, discrimination, and internal consistency. Apart from *Expert recommendations*, other constructs had acceptable ($r > 0.7$) test-retest reliability after deleting items. Differences in scores for the whole survey and each construct after the second round of data collection showed that nutrition students had higher scores ($U = 29$, $p < 0.001$) than their counterparts in engineering (Table 3.6). Head teachers total scores were 43.9 ± 9.7.

Table 3.5. Internal consistency and test-retest reliability of the items in the GNKQ before and after the deletion of items based on item difficulty and discrimination.

Topic on General Nutrition	Internal Reliability (α)				Test-Retest Reliability	
	Before		After		Before	After
	Round 1	*Round 2*	*Round 1*	*Round 2*		
Expert recommendations	0.46	0.56			0.55	
Food groups	0.81	0.81	0.87	0.85	0.80	0.80
Selecting foods	0.40	0.38	0.92	0.85	0.57	0.77
Relationship of nutrition and disease	0.77	0.84	0.89	0.91	0.78	0.84
Food fortification	0.94	0.93	0.94	0.94	0.79	0.80
Total	0.93	0.94	0.95	0.95	0.88	0.89

Table 3.6. Nutrition knowledge scores of nutrition and engineering students.

Topic (Max score)	Nutrition (*n* = 40)			Engineering (*n* = 37)			Mean Diff.	Mann-Whitney U	*p*-Value
	Min	Max	Mean (SD)	Min	Max	Mean (SD)			
Food groups (41)	28.0	41.0	36.4 (3.0)	16.0	38.0	27.6 (5.6)	8.8	127.0	<0.001
Selecting foods (2)	0.0	2.0	1.1 (1.0)	0.0	2.0	0.6 (0.9)	0.5	560	0.036
Relationship of nutrition and disease (14)	10.0	14.0	13.0 (1.1)	0.0	11.0	5.4 (2.6)	7.6	42.5	<0.001
Food fortification (22)	8.0	22.0	16.5 (3.7)	0.0	19.0	4.9 (6.1)	11.6	80.0	<0.001
Total (79)	56.0	76.0	67.0 (4.9)	20.0	67.0	38.7 (11)	28.3	29.0	<0.001

Abbreviations: Min (minimum value), Max (maximum value), SD (standard deviation), n (sample size), Diff (difference)

3.5 Discussion

Currently, there is no valid tool to collect general nutrition knowledge in Uganda or the great majority of countries in Sub-Saharan Africa. The initial GNKQ (133 items) was reviewed to include commonly consumed food items in Uganda [34,35], the concept of 'food fortification', and current nutrition-related guidelines and policies in Uganda [26,48,49]. Five experts in nutrition-related disciplines reviewed the first GNKQ drafts resulting in high consensus on the relevance of constructs (CVI and Gwet's AC1 > 0.96). Previous studies have used at least three experts to review similar questionnaires aimed at evaluating the nutrition knowledge of adults [19,20,27–31]. None of these studies, however, reported the level of agreement among experts on the relevance of the contents of the different constructs of the GNKQs. The content validity index (CVI) is a one proportion agreement method that has been used in the past to quantitatively estimate content validity [40,44]. Experts in survey evaluation suggest reporting at least two measures of agreement [40,50–52]. Relying on only CVI is not adequate because it might inflate

agreement among experts since there is no adjustment for chance agreement [50]. Gwet's AC1 was used as a second measure of agreement because of the small sample size of experts and stability concerns of the Kappa statistic. Gwet's AC1 is a more stable measure of interrater agreement reliability than the commonly used kappa statistic [42]. The recommended minimum item-CVI is 0.8, while the scale-CVI is 0.9, when using a panel of five or more experts. In the case that less than five experts review the questionnaire, there should be a perfect agreement, i.e., a CVI of 1.0 [40,44]. A Gwet's AC1 above 0.4 represents intermediate to excellent agreement reliability [42]. Therefore, the GNKQ for Uganda had adequate content validity.

The results from overall internal consistency, test-retest reliability, and construct validity of the questionnaire before and after the deletion of items based on item difficulty and discrimination were adequate and comparable to other studies [19,27,28,32,46]. Results from the validation of a similar questionnaire for adults (n = 125 college students) in Turkey [27] yielded poor internal consistency for knowledge on *Expert recommendations* ($\alpha = 0.47$) and *Selecting food* ($\alpha = 0.43$). These results are comparable to those in this study after the first round of validation with students. Similar to previous studies [19,27,28,32,46], the internal consistency ($\alpha > 0.7$) and test-retest reliability ($r > 0.7$) were adequate for three domains of nutrition knowledge i.e. *Food groups, Selecting food, Relationship of nutrition and disease*. The poor results on 'expert recommendations' may be due to discordant interpretations of nutrition messages partly attributed to limited nutrition education promotion and a lack of unified dietary guidelines in Uganda [24]. Low internal consistency has also been attributed to the heterogeneity of populations with a varied education background [22,34]. The current study included teachers and students with different education backgrounds. Administering the GNKQ to a larger homogenous sample (e.g. head teachers only) could improve these findings on internal consistency. All versions of the GNKQ validated in different countries showed good construct validity [19,27,28,32,46]. Similar to these studies, nutrition students scored higher than engineering students on the overall score and in each topic, demonstrating that the GNKQ has adequate construct validity.

Even though results obtained in this study support the validity of the questionnaire to evaluate the nutrition knowledge of adults, there are some limitations. In this study, the focus was on developing a nutrition knowledge questionnaire for adults with the ultimate goal to evaluate nutrition knowledge among head teachers, as they are often recruited in the implementation of government nutrition policies. The educational attainment of head teachers is higher than most of

the low-income population in Uganda, which requires further adaptation of the GNKQ for populations with limited education. In addition, the GNKQ mainly evaluates declarative rather than procedural knowledge. The questionnaire, however, could be used as a first step in the evaluation of attitudes and behaviors toward nutrition. Although very common in the literature, the use of students to evaluate construct validity may not be appropriate to establish this attribute in a more diverse adult population.

The development of instruments to collect valid and reliable data is critical for both scientists and practitioners, particularly in Sub-Saharan Africa. The items in the revised GNKQ draft had good validity and reliability in a sample obtained from Kampala district. Kampala is represented by diverse population groups including urban, peri-urban, rural, agricultural, cultural groups, the affluent, and the poor. This diversity potentiates the ability of the GNKQ to obtain valid results when used in other regions. Potentially, the questionnaire can be used to collect information on nutrition knowledge and its change after interventions among various population groups, especially opinion leaders or influential agents such as teachers, agriculture extension agents, and health workers. Moreover, the adaptability of the questionnaire can be evaluated in other countries in Sub-Saharan Africa. Future studies will continue the validation of this questionnaire in a larger population as well as address its predictive validity on nutrition and health behavior changes among adults.

3.6 Conclusions

The results demonstrate that the modified general nutrition knowledge questionnaire has items that can be used to collect valid and reliable nutrition knowledge data from head teachers in Uganda. The items had acceptable construct validity; content and face validity, internal consistency, and test-retest reliability. The items in the questionnaire can be used as they are to collect nutrition knowledge data for other groups of adults in Uganda. Food items of the GNKQ should be reviewed when applying it on a different population.

3.7 References

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CHAPTER 4: INTERNAL CONSISTENCY AND TEST-RETEST RELIABILITY OF THE GENERAL NUTRITION KNOWLEDGE QUESTIONNAIRE USING HEAD TEACHERS FROM SCHOOLS IN MUKONO AND WAKISO DISTRICTS

Abstract

Valid and reliable questionnaires are necessary to improve the existence and quality of nutrition information in low-resource settings, especially in opinion leaders and change agents. The present study evaluated the internal consistency and test-retest reliability of a general nutrition knowledge questionnaire (GNKQ) in a large sample of head teachers. Internal consistency was determined using Cronbach alpha (α) on a sample of 255 head teachers. Test-retest reliability on scores was determined by Pearson's correlation coefficient (r) and intraclass correlation coefficient ($ICC_{2,1}$). The overall internal consistency was α = 0.89 and 0.92 at time one and two, respectively, on 94 items. All domains had items that yielded data with acceptable internal consistency (α > 0.7). Results on test-retest reliability of two domains, *Expert recommendation* (ICC = 0.64) and *Selecting food (*ICC = 0.41) were not acceptable (r < 0.7 and ICC < 0.7) and therefore their items were removed from the proceeding analyses. The remaining nutrition knowledge domains had acceptable test-retest reliability: *Food groups* (ICC = 0.9), *Relationship of nutrition and disease* (ICC = 0.91), and *Food fortification* (ICC = 0.95). Results showed that 85 items in the draft nutrition knowledge questionnaire had acceptable internal consistency and test-retest reliability. Demographic characteristics such as age, sex, and education level had a small, but not significant effect on the nutrition knowledge scores. School ownership status (government vs. private) had a significant small to medium effect on the scores of nutrition knowledge of head teachers (d = 0.3, t (203) = -2.1, p < 0.05). In addition, sources of information such as from the *Internet* (d = 0.3, t (239) = 2.2, p < 0.05), *health service providers* (d = 0.5, t (249) = 3.6, p < 0.001) , *media* (d = 0.5, t (246) = 3.5, p < 0.001) had a significant small to medium effect on the scores of nutrition knowledge of head teachers. These results show that the questionnaire developed earlier can be used to evaluate general nutrition knowledge among head teachers. Future studies can use the questionnaire on another group of adults to improve generalizability. Also, future studies can use the GNKQ to relate nutrition knowledge and practices.

4.1 Introduction

In a previous study [1], 60 items of the GNKQ were found to yield results with unacceptable reliability. These results were attributed to different population groups that were recruited in that study. The previous study recruited students and head teachers which may have increased differences in demographic characteristics. Demographic characteristics such as education and age have been shown to associate with differences in nutrition knowledge data [2, 3] and therefore reducing reliability. Differences in nutrition knowledge as a result of diversity of demographic characteristics increase variability in answers and hence influence reliability [4]. Also the sample size (n =117) recruited in that study [1], is referred to as small i.e. below 200 [5].

Therefore, the objective of Chapter 4 was twofold: 1) to continue with the validation process of the GNKQ by determining the internal consistency and test-retest reliability on a larger and diverse sample of head teachers; and, 2) to gather baseline data on the nutrition knowledge of head teachers of schools in the Mukono and Wakiso Districts. The author tested the working hypothesis that items in the GNKQ are valid and reliable to evaluate nutrition knowledge among head teachers. This hypothesis is important because the reliability and validity of questionnaires are population and sample specific [6], and thus, expanding the sample size and its geographical location will further provide evidence to support the validity of the questionnaire to evaluate nutrition knowledge.

The findings are important because, for the first time, the nutrition knowledge using a large population of head teachers, or any population for that matter, in Uganda was collected with psychometric measures (i.e., internal consistency and test-retest reliability) reported. This pilot level survey addressed issues associated with internal consistency and reliability that arose from the previous validation step in Chapter 3. The rationale for undertaking the studies is that successful completion of the research activities will enable the scientific community to examine nutrition knowledge among head teachers and its potential influence on school nutrition and implementation of nutrition interventions. Some of the recommendations in the school feeding guidelines have been implemented at schools. However, nutrition knowledge of head teachers, let alone, the whole community, is still unknown. This study also provides the baseline data on nutrition knowledge of head teacher in Mukono and Wakiso districts in Uganda.

4.2 Methods

Population and sample size calculation. A random sample of 255 head teachers working in the Mukono and Wakiso Districts were recruited for this study. The sample size was obtained using G-power power sofware (Germany) and procedure for sample calculation [7]. The proportion 40% for school without meals and 60% with meals as obtained from the World Bank study [8], an error of 5%, power of 85% and allocation ratio of one were used to calculate sample size (234). The budget allowed to have extra 21 participants incase of dropout obtaining the total of 255 head teachers/ schools. The lists of schools were obtained from the District Education Officers (DEO) of Mukono and Wakiso Districts. There were 1893 schools in the lists of which about 800 were indentified as complete day-schools, which were the targets in this study.

The sample size was enough for computing internal consistency. For years, studies that include computation of cronbach alpha recommended a minimum sample of 500 [5]. Later studies recommended a minimum sample size of 200 participant [4] and using first Eigenvalues to compute sample size [5]. The minimum sample sizes for Eigenvalues < 3, 3-6 and above 6 are n = 300, 100 and 32 respectively, to yield unbiased results. The Eigenvalues were obtained using dimension reduction analysis in Statistical Package for Social Sciences (SPSS v23.0, IBM Corporation, Armonk, NY, USA). The first Eigenvalues for the domains in nutrition knowledge questionnaire in this study were: on *Expert recommendations* (λ = 3.2), *Food groups* (λ = 7.53), *Selecting food* (λ = 1.7), *Relationship of nutrition and disease* (λ = 3.3), *Food fortification* (λ = 6.04) and the *Total score* (λ = 10). Therefore, apart from a domain on *Selecting food*, the sample sizes, 255 and 227 obtained at time one and two were adequate for internal consistency analysis to produce unbiased results [5].

The sample size (n = 136) was adequate to run test-retest reliability analysis. Since intraclass correlation coefficient (ICC) is derived from analysis of variance ($\frac{\text{between subject variance}}{\text{between subject variance+error}}$), it is conceptually similar to R^2 [9]. The minimum required sample sizes for test-retest reliability analysis were obtained using the values of ICC obtained in Table 4.3, power of 95%, error of 0.05, 2 factors (time one and two). The ICC were used to compute Cohen's f^2 (effect size) using the guidelines in another study [10]. The procedure for sample size computation for linear regression in G-power was used [7]. The minimum sample sizes were: *Expert recommendations* (n = 13), *Food groups* (n = 7), *Selecting food* (n = 26), *Relationship of*

nutrition and disease ($n = 6$), *Food fortification* ($n = 6$) and the *Total score* ($n = 6$). Also the sample size was tested whether it was adequate for correlation analysis between time one and two on the final scores after removing items. The procedure for sample size computation for correlation analysis in G-power was used [7]. Values of Pearsons's correlation coefficients (Table 4.2), error (0.05), and power (95%) obtained similar sample sizes as computations for ICC. Therefore, sample size of 136 participants was adequate for test-retest reliability analysis. Also the recent study on validation of nutrition knowledge questionnaire [2], referred to 100 participants as adequate for test-retest reliability analysis.

Subjects. The contact information of the head teachers corresponding to the selected schools was obtained from the respective District Education Offices (DEO) of Mukono and Wakiso. Head teachers were contacted prior to enrollment via telephone. During this initial contact, they were informed of the purpose of the study, and if interested, they were asked to provide their oral consent and scheduled for a visit. Only head teachers who provided oral consent were visited at their schools. The characteristics of schools and head teachers are reported in Table 4.1. The majority of the schools selected were government supported (public) (54%), located in urban areas (54%) and had a supplementary feeding program present (71%). Forty-five percent of the selected schools had female head teachers. The majority of the head teachers were between 35 and 54 years (69%), had attained diploma or degree education qualification (77%) and had more than three children (55%).

Enumeration. A total of two enumerators along with the author collected of all the data. The author trained the enumerators in two sessions lasting four hours each. During these sessions, the author explained the goal of the study, the research activities, and the role of each enumerator. The enumerators were involved in contacting the selected head teachers and schedule the time for visiting the schools. Each day, schools were marked in a working map and a data collection route was created. The route was based on the shortest distances between schools to make data collection efficient. The enumerators were dropped at specific sites following this map. At the schools, they went through the consent form and asked the head teachers to sign the consent form. After the head teachers signed the consent form, the enumerators provided the questionnaires to the head teachers and answered any questions raised by the head teachers. When schools were close to each other, ennumerators walked to the next school to administer the questionnaire. Enumerators left the surveys with the head teachers to fill and picked them at the end of the day. They collected the

completed surveys and checked the forms for missing data before leaving the field. If missing information was found, enumerators asked the head teachers to address missing fields.

Table 4.1. Characteristics of the selected schools and head teachers.

Characteristic of head teacher	***n***	**%**
Gender (N=255)		
Male	138	54.1
Female	117	45.9
Age (N=255)		
18–24	4	1.6
25–34	48	18.8
35–44	83	32.5
45–54	93	36.5
55–64	25	9.8
65–74	2	0.8
Education (N=255)		
Primary	6	2.4
Ordinary Secondary school	11	2.0
High School (A' level)	3	1.2
Technical college	36	14.1
Diploma	113	44.3
Degree	82	32.2
Post graduate degree	10	3.9
Number of children (N = 255)		
None	17	6.7
1	15	5.9
2	36	14.1
3	47	18.4
4	58	22.7
≥5	82	32.2
Ownership status and location of schools		
Government	117	53.7
Private	101	46.3
Rural	100	45.9
Urban	118	54.1
Availability of SFP		
Yes	155	71.1
No	63	28.9

Instrument. The general nutrition knowledge questionnaire (GNKQ) was reviewed and modified based on the results in Chapter 3 and administered to the selected head teachers during the visits at the school. All questionnaires were individually filled by the head teachers. The GNKQ consisted of five domains (137 items) on: *Expert recommendations* (16 items), on *Food groups*

(67 items), *Selecting food* (10 items), the *Relationship of nutrition and disease* (22 items), and *Food fortification* (22 items) (Appendix 2). During visits, the head teachers provided written consent and filled out the questionnaire. Although the questionnaire in the previous study took 30-45 minutes to fill out, head teachers had between 2 to 3 hours to complete the work as it was taken during work days. Meanwhile, the enumerator moved to the next selected school to start a new survey. The head teachers individually filled the questionnaire twice in the span of two weeks. Two hundred and twenty-seven head teachers completed the the questionnaire twice. However, one hundred thirty-six head teachers completed the questionnaire in the second week, in the allocated time span, and therefore only those were included in the test-retest analysis.

Data clean up, mining and analysis. All questionnaires were thouroughly checked to ensure each item was responded to before leaving the field. Head teachers were asked to complete filling the questionnaire before leaving the field. All data were entered in the Statistical Package for Social Sciences (SPSS v23.0, IBM Corporation, Armonk, NY, USA) for analysis. The GNKQ consisted of the same five domains on nutrition knowledge and 137 items (Table 4.2), which represented the maximum score (i.e., 137 points). The answers were scored using a procedure previously reported [1], in which right answers were assigned one point and wrong ones or unsure responses were given no points. Other sections (i.e., sources of nutrition information and demographics) were not scored. One respondent with unfilled nutrition knowledge items was eliminated from analysis of round two.

Data from all subjects (n = 255 at time one and n = 227 at time two) were used to ascertain item difficulty, item discrimination and internal consistency as previously explained [1], and n = 136 for test-retest reliability. Items that were answered correctly by 10% – 90% of the respondents (acceptable item difficulty) were included in the analysis. Items with item-to-total correlation coefficient, $r < 0.2$ (unacceptable discrimination) were removed from the analysis. Items that did not meet this criterion were removed from the analysis. Cronbach alpha (α) was obtained from dichotomized values of each domain and the whole questionnaire (correct =1, wrong or unsure responses = 0) using SPSS23. Domains with $\alpha > 0.7$ were considered with adequate internal consistency. All items with acceptable item difficulty and discrimination from domains with acceptable internal consistency were used to generate total scores for each of five nutrition knowledge domains and the whole questionnaire. Test-retest reliability was evaluated using procedures from other studies [11, 12]. Only questionnaires that were completed at both intances

were used. Pearson's correlation coefficient (*r*), and intraclass correlation coefficient ,two-way random, single measure, absolute agreement ($ICC_{2,1}$) were used to evaluate test- retest reliablity (Table 4.2 and 4.3). The 95% Confidence intervals for the ICC were also obtained. Before running the paired *t*-test data was checked for normality and found to be non-normal. With large enough sample size ($n > 30$), like in case of this study ($n = 136$) the violation of normality should not cause problems, hence parametric procedure used even when data was non-normal [13].

Table 4.2. Internal consistency and test-retest reliability of nutrition knowledge domains before and after removal of items based on item-difficulty and item-discrimination.

Topic on General Nutrition (items before, after)	**Internal Reliability (α)**				**Test-Retest Reliability (*r*)**	
	Before		**After**			
	Time 1 N= 255	***Time 2 N= 227***	***Time 1 N =255***	***Time 2 N= 227***	**[1]Before *N = 136***	**[2]After *N = 136***
Expert recommendations (16,10)	0.65	0.68	0.70	0.75	0.67	0.65
Food groups (67, 45)	0.81	0.86	0.86	0.89	0.90	0.90
Selecting food (10, 2)	0.19	0.34	0.80	0.83	0.72	0.42
Relationship of nutrition and disease (22, 15)	0.61	0.66	0.70	0.73	0.83	0.91
Food fortification (22, 22)	0.86	0.87	0.86	0.87	0.95	0.95
Total (137, 94)	0.87	0.91	0.89	0.92	0.96	0.97

[1]Before removing items with poor item difficulty and discrimination from analysis. [2]After removing items with poor item difficulty and discrimination from analysis. ONLY 136 head teachers who filled the questionnaire on second week (time two) are included.

Wilcoxon Signed Ranks Test was used to determine differences in scores at time one and two. Paired *t*-test for the mean differences of scores at time one and two were used to assess bias in the results of test-retest reliability (Table 4.3). The acceptable test-retest reliability was $r > 0.7$ [1], ICC > 0.7 [2] and $p > 0.05$ for the mean differences of scores implied unbias in the results [11]. The classifications of ICC of the test-retest reliability was used to specify the strength as explained [12]. An ICC below 0.20 was considered poor agreement, from 0.21 to 0.40 fair agreement, from 0.41 to 0.60 moderate agreement, from 0.61 to 0.80 substantial agreement, and from 0.81 to 1 perfect agreement. Domains with results not fitting the criteria for test-retest were considered with inadequate test-retest reliability to evaluate nutrition knowledge in adults.

Table 4.3. Test-retest reliability of nutrition knowledge scores and measures.

Topic (Max score)	Time one Mean (SE)	Time two Mean (SE)	Mean diff (SE)	*t* (*p*-value) df =135	$ICC_{2,1}$	ICC 95% interval
			***N* =136**			
Expert recommendations (10)	8.4 (0.16)	8.5 (0.15)	-0.1 (0.13)	-1.0 (0.32)	0.64	0.53 - 0.73
Food groups (45)	33.1 (0.59)	32.9 (0.61)	0.2 (0.27)	0.6 (0.55)	0.90	0.86 - 0.93
Selecting foods (2)	0.9 (0.08)	0.7 (0.08)	0.2 (0.08)	1.9 (0.06)	0.41	0.26 - 0.54
Relationship of nutrition and disease (15)	7.9 (0.22)	8.1 (0.23)	-0.2 (0.09)	-1.9 (0.06)	0.91	0.87 - 0.93
Food fortification (22)	7.1 (0.47)	7.2 (0.45)	-0.1 (0.15)	-0.6 (0.55)	0.95	0.93 - 0.96
Total (94)	57.4 (1.02)	57.5 (1.03)	-0.1 (0.25)	-0.3 (0.77)	0.97	0.96 - 0.98

Intraclass correlation coefficient (ICC), using a two-way random model with an absolute agreement type, single measure), with 95% confidence interval (CI). Standard error (SE). *$p < 0.05$ for the mean differences.

Statistical analyses. Descriptive statistics were generated including the mean, standard deviation, and standard error of means. Data were disaggregated by gender, age, type of schools (private vs. government funded), location (rural vs. urban), and availability of school meals. All data was checked for normality and most of it was found to be non-normal. However, the sample sizes used in analysis were above 30, which violation of normality should not cause problem [13], parametric analysis procedures were used. The Uganda Bureau of Statistics defines an urban area as gazetted cities, municipalities and towns with a population of more than 2,000 people [14]. Places that did not fit this definition were categorized as rural areas. Knowledge scores were presented as standard error of the mean to allow comparison of nutrition knowledge from other studies. The means were separated using independent *t*-test and Tukey HSD posthoc tests. The effect sizes Cohen's *d* and partial eta squared (η_p^2) of the independent variables on nutrition knowledge scores were obtained and interpreted using established guidelines [15, 16]. Using Cohen's *d*, effect sizes were classified as small (0.2), medium (0.5), and large (0.8). Using partial eta squared (η_p^2), the effect sizes were classified as *small* (0.01), *medium* (0.06), and *large* (0.14). Effect sizes have advantages: 1) they provide the magnitude of the effect, 2) they are not affected by sample size making them suitable for comparisons across population, and 3) they are used to calculate sample sizes for new studies [15, 16]. A few studies including nutrition knowledge as a depedent variable have reported effect sizes, *d* between 0 to 1.2 [2]. Statistical significance was estimated at $p < 0.05$.

Human Subject Research compliance. The Institutional Review Board at the University of Illinois (IRB#15469) and the Uganda National Council for Science and Technology (No. SS 3700)

approved all research protocols. District Education Offices of Mukono and Wakiso provided permissions to conduct studies. All subjects provided oral and written consent before participation.

4.3 Results

The demographic characteristics of the the teachers and schools are reported in Table 4.1. The sample contained more male (54%) head teachers than female (46%) head teachers which coincided with the proportion of head teachers based on gender. There were more head teachers with a diploma (44%) and degrees (32%). The majority of the head teachers were adults aged between 35 and 55 years. About 29% of the schools where the head teachers were working did not have a school feeding program.

Reliability of items in the general nutrition knowledge questionnaire

Internal consistency. Before removing the items with unacceptable items-difficulty and discrimination, the overall scale (GNKQ) had acceptable internal consistency ($\alpha = 0.87$ and 0.91) at time one and two, respectively (Table 4.2). The internal consistency (α) for *Expert recommendations* ($\alpha = 0.65, 0.68$), *Selecting foods* ($\alpha = 0.19, 0.34$), and *the Relationship of nutrition and disease* ($\alpha = 0.61, 0.66$) at both time points was below 0.7. After removing items with poor item- difficulty and -discrimination, the total number was reduced to 94 items and the internal consistency of the whole instrument was $\alpha = 0.89$ and 0.92 at time one and two, respectively. Domains with the final items had an $\alpha > 0.7$ at time one and two, with *Expert recommendation* (10 items, $\alpha = 0.7$ and 0.75), *Selecting foods* (2 items, $\alpha = 0.8$ and 0.83), and *Relationship of nutrition and disease* (15 items, $\alpha = 0.7$ and 0.73), respectively. *Food groups* and *Food fortification* had acceptable internal consistency ($\alpha > 0.7$) at time one and two, before and after removing of items with unacceptable item difficulty and discrimination.

Test-retest reliability. The overall test-retest reliability using correlation coefficient, *r* of the GNKQ before and after removing items with unacceptable item difficulty and discrimination was 0.96 and 0.97 respectively. Before and after removing items unacceptable difficulty and discrimination, the test-retest reliability, *r* for scores of *Expert recommendations* ($r = 0.67$ and 0.65) were below 0.7. After removing items based on item difficulty and discrimination, the final, *r* on scores *for Selecting food* ($r = 0.42$) was below 0.7. All other domains had acceptable, *r* before and after removal of items based on item difficulty and discrimination. The intraclass correlation

coefficient for each domain was obtained using only the scores generated from items with acceptable item-difficulty and discrimination (Table 4.3). The overall ICC for the total score between time one and two was 0.97. Scores on *Expert recommendations* (0.64) and S*electing food* (0.41) had ICCs below 0.7. Other nutrition knowledge domains had ICCs above 0.7. The mean difference of the total scores between time 1 and 2 was not different from zero, t (135) = -0.30, p = 0.77. Similarly, there were no differences ($p > 0.05$) between the mean scores at time one and two for each nutrition knowledge domain using the Wilcoxon Signed Ranks Test.

Association of nutrition knowledge scores and head teacher characteristics

Gender. Male head teachers scored higher than their female counterparts, although not statistically different ($p > 0.05$) (Table 4.4).

Age. There were no significant differences in the nutrition knowledge scores among head teachers of different age groups.

Education attainment. Head teachers with at least a degree had higher nutrition knowledge scores than those without degrees; however not reaching significance.

Number of children. The mean scores among the head teachers with different number of children were not significantly different ($p > 0.05$).

Association of nutrition knowledge scores and school characteristics

Availability of school feeding. There was no difference ($p > 0.05$) between the scores of head teachers from schools that have a school feeding program and those without (Table 4.5).

Ownership of the school. Head teachers from government schools scored higher than those from private schools specially in *Total score*, (t (203) = -2.1, p = 0.03) and *Food groups* (t (203) = -2.5, p = 0.01) and *Relationship of nutrition and disease* (t (203) = -2.6, p = 0.01). The effect sizes of the mean score differences were *Food groups* (0.4), *Relationship of nutrition and disease* (0.4), and *Total score* (0.3).

Location of the school. There were no differences ($p > 0.05$) in the knowledge scores between head teachers from rural and urban schools.

Table 4.4. Association of nutrition knowledge scores and head teachers' characteristics.

		Food groups (Max score =45)	Relationship of nutrition and disease (Max score =15)	Food fortification (Max score = 22)	Total (after test-retest) (Total score = 82)
Gender					
Male (*n* =138)	Mean (SE)	33.0 (0.62)	7.4 (0.24)	7.9 (0.43)	48.3 (0.96)
Female (*n* =117)	Mean (SE)	32.0 (0.69)	7.9 (0.24)	6.9 (0.48)	46.9 (1.04)
t (df =253)		1.0	-1.3	1.5	1.0
Effect size (*d*)		0.1	0.2	0.2	0.1
Age					
18-34 (*n* =52)	Mean (SE)	32.8 (1.10)	7.1 (0.37)	8.2 (0.72)	48.1 (1.65)
35-54 (*n* =176)	Mean (SE)	32.8 (0.55)	7.8 (0.20)	7.4 (0.38)	48.1 (0.84)
Above 54 (*n* =27)	Mean (SE)	30.1 (1.25)	7.5 (0.61)	6.2 (1.07)	43.8 (2.06)
F (2,252)		1.59	1.59	1.35	1.74
Effect size (η_p^2)		0.01	0.01	0.01	0.01
Highest attained education level					
No degree (*n* = 163)	Mean (SE)	32.2 (0.63)	7.5 (0.21)	7.7 (0.40)	47.4 (0.93)
With degree (*n* =92)	Mean (SE)	33.2 (0.63)	7.9 (0.28)	7.1 (0.54)	48.1 (1.07)
t (df =253)		-1.1	-0.9	0.87	-0.5
Effect size (*d*)		0.1	0.1	0.1	0.1
Number of children					
None (*n* =17)	Mean (SE)	30.9 (2.36)	7.3 (0.72)	7.6 (1.41)	45.9 (3.77)
1 (*n* =15)	Mean (SE)	31.9 (1.74)	8.0 (0.52)	8.6 (1.38)	48.5 (2.42)
2 (*n* =36)	Mean (SE)	33.5 (1.13)	7.3 (0.41)	7.3 (0.87)	48.1 (1.69)
3 (*n* = 47)	Mean (SE)	34.1 (0.91)	7.9 (0.40)	7.4 (0.78)	49.3 (1.47)
4 (*n* =58)	Mean (SE)	31.8 (1.00)	7.4 (0.36)	7.1 (0.63)	46.3 (1.46)
More than 4 (*n* = 82)	Mean (SE)	32.2 (0.84)	7.8 (0.31)	7.6 (0.56)	47.6 (1.31)
F (5, 249)		0.9	0.4	0.2	0.5
Effect size (η_p^2)		0.0	0.0	0.0	0.0
Do you children below 18 years?					
Yes (*n* =194)	Mean (SE)	33.0 (0.50)	7.8 (0.18)	7.4 (0.37)	48.2 (0.77)
No (*n* =59)	Mean (SE)	31.0 (1.12)	7.0 (0.40)	7.6 (0.65)	45.6 (1.67)
t (df=251)		1.9	2.0*	-0.3	1.553
Effect size (*d*)		0.3	0.3	0.1	0.2

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

Table 4.5. Association of nutrition knowledge scores and school characteristics.

		Food groups (Max score =45)	Relationship of nutrition and disease (Max score =15)	Food fortification (Max score = 22)	Total (after test-retest) (Total score = 82)
Availability of the school feeding					
No SFP (*n* =57)	Mean (SE)	34.1 (0.76)	8.3 (0.39)	7.9 (0.66)	50.3 (1.34)
SFP (*n* = 148)	Mean (SE)	33.3 (0.58)	8.0 (0.21)	8.4 (0.44)	49.7 (0.94)
t (df =203)		0.7	0.7	-0.6	0.3
Effect size (*d*)		0.1	0.1	0.1	0.1
Ownership of the school					
Private (*n* = 96)	Mean (SE)	32.3 (0.78)	7.6 (0.26)	8.3 (0.54)	48.2 (1.18)
Government (*n* =109)	Mean (SE)	34.7 (0.54)	8.5 (0.25)	8.2 (0.51)	51.4 (1.00)
t (df =203)		-2.5*	-2.6*	0.1	-2.1*
Effect size (*d*)		0.4	0.4	0.0	0.3
Location of the school					
Urban (*n* =112)	Mean (SE)	34.1 (0.62)	8.0 (0.24)	8.4 (0.51)	50.4 (1.05)
Rural (*n* = 93)	Mean (SE)	32.9 (0.72)	8.2 (0.29)	8.0 (0.52)	49.2 (1.14)
t (df =203)		1.2	-0.8	0.6	0.8
Effect size (*d*)		0.2	0.1	0.1	0.1

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$. School feeding program (SFP). Uganda Bureau of Statistics defines an urban area as gazetted cities, municipalities, and towns with a population of 2,000 people or more [13].

Association of nutrition knowledge scores and sources of information

Internet. The head teachers who used the internet as a source of nutrition information had higher scores than those who did not on *Total score* (t (239) = 2.2, p = 0.03) (Table 4.6). Nutrition knowledge domains that differed with internet use were *Relationship of nutrition and disease* (t (239) = 2.6, p = 0.01) and *Food fortification* (t (239) = 2.2, p = 0.03). The effect sizes (d) of the mean score differences with internet use were for *Relationship of nutrition and disease* (0.4), *Food fortification* (0.3) and *Total score* (0.3).

Schools. Nutrition information was obtained from the schools previoulsy head teachers attended for their education. The schools (i.e., previous primary, secondary or university classes) were a significant source of nutrition information for head teachers, *Total score* (t (247) = 3.0, p = 0.001) (Table 4.6). Head teachers that referred to schools as sources of nutrition information had higher scores on the following domains: *Food groups* (t (247) = 2.5, p = 0.01) and *Food fortification* (t (247) = 2.1, p = 0.04). The effect sizes (d) were above 0.2 for all mean score differences in all domains: *Food groups* (0.4) *Relationship of nutrition and disease* (0.3), *Food fortification* (0.4) and *Total score* (0.5).

Table 4.6. Association of nutrition knowledge scores and sources of nutrition information.

		Food groups (Max score =45)	Relationship of nutrition and disease (max score =15)	Food fortification (Max score = 22)	Total (after test-retest) (Total score = 82)
Internet					
Yes (*n* = 170)	Mean (SE)	32.9 (0.5)	7.9 (0.2)	7.8 (0.4)	48.6 (0.8)
No (*n* = 71)	Mean (SE)	31.9 (1.0)	6.9 (0.3)	6.2 (0.6)	45.0 (1.5)
t (df =239)		1.0	2.6*	2.2*	2.2*
Effect size (*d*)		0.1	0.4	0.3	0.3
Schools					
Yes (*n* = 210)	Mean (SE)	33.2 (0.46)	7.8 (0.19)	7.7 (0.35)	48.6 (0.73)
No (*n* =39)	Mean (SE)	30.0 (1.59)	6.9 (0.39)	5.8 (0.87)	42.8 (2.26)
t (df = 247)		2.5*	1.9	2.1*	3.0**
Effect size (*d*)		0.4	0.3	0.4	0.5
Peers and friends					
Yes (*n* = 170)	Mean (SE)	32.9 (0.51)	7.9 (0.20)	7.8 (0.38)	48.6 (0.79)
No (*n* = 80)	Mean (SE)	32.0 (0.96)	7.2 (0.32)	6.6 (0.59)	45.7 (1.48)
t (df = 248)		0.9	2.0*	1.8	1.9
Effect size (*d*)		0.1	0.3	0.2	0.2
Health workers					
Yes (*n* = 203)	Mean (SE)	33.2 (0.47)	7.9 (0.18)	7.8 (0.35)	48.8 (0.73)
No (*n* = 48)	Mean (SE)	30.0 (1.35)	6.6 (0.40)	5.9 (0.76)	42.5 (1.91)
t (df =249)		2.7**	3.1**	2.3*	3.6***
Effect size (*d*)		0.4	0.5	0.4	0.5
Parents					
Yes (*n* = 163)	Mean (SE)	32.2 (0.59)	7.9 (0.21)	7.9 (0.39)	48.0 (0.89)
No (*n* = 85)	Mean (SE)	33.3 (0.76)	7.2 (0.29)	6.4 (0.59)	47.0 (1.25)
t (df = 246)		-1.1	1.7	2.1*	0.6
Effect size (*d*)		0.1	0.2	0.3	0.1
Radio, television, and magazines					
Yes (*n* = 211)	Mean (SE)	33.1 (0.46)	7.8 (0.19)	7.8 (0.34)	48.7 (0.72)
No (*n* = 39)	Mean (SE)	29.9 (1.63)	6.9 (0.41)	5.4 (0.86)	42.2 (2.23)
t (df = 248)		2.6*	1.8	2.7**	3.3***
Effect size (*d*)		0.4	0.3	0.5	0.5

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

Peers and friends. Head teachers that sought peers and friends as sources of nutrition information had higher scores only for the domain on *Relationship of nutrition and disease* (t (248) = 2.0, p = 0.05).

Health workers. The head teachers that referred to health service providers as a source of nutrition information scored higher in all nutrition knowledge domains, *Food groups* (t (249) = 2.7, p = 0.01), *Relationship of nutrition and disease* (t (249) = 3.1, p = 0.002) and *Food fortification* (t (249) = 2.3, p = 0.02), and *Total score* (t (249) = 3.6, $p < 0.001$). All the effect sizes (d) were

above 0.2 for all domains: *Food groups* (0.4), *Relationship of nutrition and disease* (0.5), *Food fortification* (0.4) and *Total score* (0.5).

Parents. Head teachers who referred to their parents as a source of nutrition information in the domain of *Food fortification* (t (246) = 2.1, p = 0.03) had higher nutrition scores. For this domain, the effect size (d) for the mean score difference was 0.3.

Radio, television and margazines. The head teachers that used *radio*, *television* and *margazines* to seek nutrition information had higher scores in the following knowledge domains: *Food groups* (t (248) = 2.6, p = 0.01), *Food fortification* (t (248) = 2.7, p = 0.01), and the *Total score* (t (248) = 3.3, $p < 0.001$). Differences in the score means presented effect sizes (d) above 0.2 in all domains: *Food groups* (0.4), *Relationship of nutrition and disease* (0.3), *Food fortification* (0.5) and *Total score* (0.5).

4.4 Discussion

The aim of this study was to determine the internal consistency and test-retest reliability of the revised GNKQ administered to a larger sample (n = 255) of head teachers in Uganda. This is also the first study that attempts to explore the general nutrition knowledge of head teachers, an influential adult group in Uganda. The previous study [1] determined that the items in the questionnaire used in this study had acceptable content and face validity to evaluate nutrition knowledge in this population. Nonetheless, a number of items within several knowledge domains had unacceptable reliability. Several authors [2, 4, 6] have recommended evaluating knowledge instruments using larger sample before items and domains are removed.

The internal consistency of 94 items in the GNKQ was acceptable ($\alpha > 0.7$). These results showed increased number of items yielding acceptable reliability when compared to a previous study (Chapter 3, 79 items) [1]. All knowledge domains had acceptable internal consistency, which was different from the pilot study [1]. Internal consistencies are known to be different between samples from the same population [6]. The domain on *Food groups* had the highest results on internal consistency, 0.86 and 0.89 for time one and two, respectively. This might be attributed to the high number of items included in this domain. In general, internal consistency can be modified by increasing sample size, increasing number of items in the questionnaire, and reviewing the questionnaire to reduce ambigous and difficult items, and having clear instructions to reduce response burden [5, 6]. Other factors that influence reliability are variations in administration of

the questionnaire include different modes of adminstration of the questionnaire, timing of administering the questionnaire, and use of a proxy or self reporting [4]. Test length, timing of the test, sample homogeneity, objectivity of the test items, and poor understanding of the instructions influence reliability. Generally, the longer a test is, the more reliable it is; timed test presents reliability problems; heterogenous samples yield better reliability of the test scores; objective tests also obtain reliable scores; and misunderstanding of test instructions may cause variation in the test results hence poor reliability [17].

After the test-retest reliability, a measure of the stability of results within a timeframe, two domains (*Expert recommendations* and *Selecting food*) were dropped from the proceeding analysis because the results from items had unacceptable test-retest reliability ($r < 0.7$, ICC < 0.7). Previous studies on validation of nutrition knowledge questionnaires have used only items with acceptable reliability for further investigations involving nutrition knowledge [2, 18-20]. In the current study, removing items from analysis does not imply deleting them from the questionnaire. According to different studies [4, 6], the factors that can affect test-retest reliability are similar to those of internal consistency. Response burden and recall ability of the participants are mentioned to affect test-retest reliability. In this study, the low reliability after two weeks may be attributed to the fewer number of items in both domains (i.e. *Expert recommendations* (10 items) and *Selecting food* (2 items)). The Pearson's correlation and intraclass correlation coefficients are reduced with low number of items [4]. Future studies should consider increasing the number of items in these domains (*Expert recommendations* and *Selecting food*). Also, timing of administration might have influenced the reliability. First, the head teachers were allowed to complete the questionnaire in more than 2-3 hours considering their busy schedule. This, however, may explain the better reliability than the results obtained in Chapter 3. Second, the whole survey took place between August and November 2016, which was a busy school period. Towards the end of August 2016, schools were preparing and some conducting end of second term exams. Most schools had their second term at the beginning of September 2016. Again during the second term break, head teachers were invited to different meetings by the districts and at national level for preparation of third term as well as attend to their families. Towards the end of September 2016, most schools were preparing for opening of the third term. Most schools opened with beginning of term exams. Towards end of october, most schools were preparing for end of year exams. Head teachers were involved in making alot decisions for the various activities during this period. The heavy workload

of the head teachers might have affected their recall ability, and increased response burden. These results necessitate future studies involving head teachers to avoid survey periods involving two academic terms. In addition, low test-retest reliability scores in these two domains might be attributed to intrinsic differences of the sample [12]. The sample comprised of head teachers that used differences sources of information. As it is discussed later, factors associated with the individual (e.g., source of nutrition information) and school (private vs. public) had varying influence on nutrition knowledge. Future studies should take care of these differences and ensure that sample sizes are adequate for the different groups. The low reliability on results of the *Expert recommendations* might be attributed to the mixed messages received by adults from the effective media and other sources of information coupled with the fact that Uganda does not have dietary guidelines. Also, available health and nutrition policies and guidelines have not received wide publicity in Uganda [8]. The high level of uncertainty leading to guessing of answers may account for the variations in the answers at time one and two, thus lowering the test-retest reliability. These results demonstrate the need for country-specific nutrition guidelines with a clear and effective dissemination strategy.

Head teachers' demographic characteristics such as gender, age, education attainment and the number of children living with them at home yielded none to small, non-significant effects on knowledge scores. This was expected as head teachers in Uganda are selected from all teachers in the system, who do not receive specialized training in nutrition. In the present study, the *Total mean score* (47.6 ± 0.71) for all head teachers (n = 255) was not different from that of smaller sample (n = 40) of head teachers (43.9 ±1.53 vs. 47.6 ± 0.71; $p > 0.05$) in a previous study (Chapter 3, [1]). In the previous study (Chapter 3), the nutrition knowledge score of the head teachers was not different ($p > 0.05$) from that of the engineering students, but lower than the nutrition students attending Makerere University. This indicated that without specialized training in nutrition, the scores of any other adult group in Uganda, even those studying a Bachelor of Science degrees, would not have significant differences. The results of the present study on association of head teachers' demographic characteristics were different from those reported in study using the similar questionnaire in the United Kingdom [2]. The discrepancy may be attributed to the different samples and participants characteristics such as race, age, gender and education compared to the present study. The majority of participants in the UK study were *white* (90.7%), *had ages 18-35 years* (43.2%), *female* (74.3%), *had attained at least a degree* (47%), and significant proprotion

had a *nutrition qualification* (31.5%). In the current study, all participants were *black African,* majority *had ages 35 to 54 years* (69%), *male* (54.1%), *had attained diploma* (44.3%), and none had a nutrition qualification, rather attended nutrition training workshops. In the study in UK, a larger sample size compared to the present study (n = 451 vs. n = 255) were used on the analysis of associations of demograhic characteristics and nutrition knowledge. Therefore, the current study may have failed to obtain significance because of lower sample size. However, this study was not powered for any to those demographic characteristics.

In Uganda, availability of school feeding program (providing meals at schools) depends on several factors including: parental and community support to school activities; availability of school gardens school-level requirements like fuel (firewood, charcoal etc.); availability of facilities like school kitchens, water, and serving facilities; functional and effective institutional framework for sustained mobilization and participation of the community; and proper records management for building trust, transparency, and accountability [8]. Thus, it was expected that the presence of school feeding was not associated with knowledge scores. This is because the focus of such programs is often to provide a cold or a hot meal to children rather than including supporting programming such as on dental hygiene, food safety, nutrition education, or infrastructure (e.g., kitchens), human resource, and nutrition information.

Ownership status of the school had a small to medium significant effect on nutrition knowledge scores. This observation was independent of school location. Generally, in Uganda most government schools have access to more resources than private institutions [21]. These might include more teachers, cooking staff, and health care volunteers, a supportive and defined organizational structure, a library and other resources [21]. These resources might have contributed to significantly higher nutrition knowledge scores.

Use of the different sources of information such as internet, previous schooling and coursework, health services providers, and media (radio, television and magazines) had small to medium effect on nutrition knowledge scores. These sources are known to be good sources of nutrition information [22, 23]. In a study in United States, high nutrition knowledge was associated with using online platforms as sources of information [24]. In addition to internet, a study in Iran revealed that radios were important sources of nutrition information [25]. Using television and family members as sources of information were associated to high nutrition knowledge in sample of participants obtained from the Special Supplemental Nutrition Program for Women, Infants,

and Children (WIC) in the United States [26]. In a study in Indonesia, nutrition knowledge was associated with previous maternal schooling [27]. In Uganda, nutrition education is the purview of the Ministry of Health organization structure [28]. Thus, the use of health service providers as a source of information was expected.

Although the internal consistency and reliability of the GNKQ was established, the results are limited to the population under study. This is because only a group of head teachers, who may not represent the characteristics of other adult groups in Uganda were recruited in this study. This is a challenge as the questionnaire may not collect reliable nutrition knowledge data from other population groups hence reducing external validity and generalizability. In this study, a larger sample (n = 255) was recruited and the power analysis for all reliability analysis was reported. However, future studies involving different adult groups are important to improve external validity and generalizability. The questionnaire that was developed for UK was used in numerous surveys in other countries to collect nutrition knowledge of various groups of adults [2, 18, 19, 29], which improves the external validity of the findings in the current study. Another limitation of this study was the sample sizes at time one and two (n = 255 and 227) were smaller than the original version developed for United Kingdom (n = 391) [9], to compute internal consistency. The smaller sample size may be the reason for obtaining low internal consistency at time one leading to removal of 43 items in later analysis. Also, dropping of items, may have contributed lowered test-retest reliability in the two domains; *Expert recommendations* and *Selecting food*. Apart from *Selecting food*, the power analysis revealed the sample sizes used at time one and two (n = 255 and 227) were adequate for internal consistency computations. Future studies using the questionnaire without removing any items, should review the items and use a sample size (n) of not less than 391. In addition, like the previous study (Chapter 3), the GNKQ can mainly be used to evaluate declarative rather than procedural nutrition knowledge. Future studies can explore to identify items to evaluate procedure knowledge on promoting different ideal nutrition practices.

4.5 Conclusion

The results of this study showed that the GNKQ had knowledge domains and items that yielded reliable data on general nutrition knowledge of head teachers in Uganda. A higher number of items (94 items) compared results of Chapter 3 (79 items) [1] had acceptable reliability. However, results of items within the *Expert recommendation* and *Selecting food* domains did not

reach acceptable test-retest reliability. These domains cannot be completely disregarded as they are supportive of the breadth of nutrition knowledge. Some characteristics of the head teachers and schools were associated with head teachers' nutrition knowledge. The GNKQ can be used without deleting any items to collect reliable nutrition knowledge data among head teachers from other regions in Uganda. The questionnaire should be administered to other population groups in Uganda to improve generalizability to the adult population in Uganda.

4.6 References

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CHAPTER 5: RELIABILITY OF THE GENERAL NUTRITION KNOWLEDGE QUESTIONNAIRE ON COMMUNITY EXTENSION AGENTS IN UGANDA

Abstract

A nutrition knowledge questionnaire that was earlier developed for head teachers was administered to extension agents servicing populations living in Kiboga (n = 40) and Kyankwanzi (n = 40) districts in Uganda. The questionnaire had five nutrition knowledge domains and a total of 137 items: *Expert recommendations* (16 items), *Food groups* (67 items), *Selecting foods* (10 items), *Relationship of nutrition and disease* (22 items), and *Food fortification* (22 items). The reliability of items was determined using internal consistency (Cronbach α) and test-retest using intra correlation coefficient ($ICC_{2,1}$). The nutrition knowledge level of extension agents was determined. After removal of items based on *item difficulty* (10-90%) and *discrimination* ($r < 0.2$), the domain on *Selecting foods* lost all its items. The final questionnaire with 85 items had an internal consistency (α) of 0.93, 10 items on *Expert recommendations* (α = 0.73, 0.72), 44 items on *Food groups* (α = 0.85, 0.88), 9 items on *Relationship of nutrition and disease* (α = 0.77, 0.70), and 22 items on *Food fortification* (α = 0.9, 0.88) after the first and second test administration, respectively. The overall test-retest for the whole instrument (ICC) was 0.9, and for all knowledge domains. Domains with ICC above 0.7 were used in further analyses. The questionnaire was used to obtain reliable nutrition knowledge data of extension agents, which can be used as a baseline for future nutrition education interventions targeting this population. Therefore, the GNKQ used initially on head teachers can also be used to obtain valid and reliable nutrition knowledge data from community extension agents, further establishing its external validity.

5.1 Introduction

In the spirit of integration and delivery of services to low-income populations, extension workers, facilitators, and volunteers are some of the human resource available in the communities, often called to implement government policies and programs. Some of the policy recommendations that they implement include promotion of adequate feeding practices and behaviors, provision of care and support to the malnourished, and dissemination of food and nutrition policies [1]. These new knowledge and practices must diffuse into the communities to ensure improved health outcomes. Diffusion is the process by which innovations (i.e., nutrition recommendations) are communicated through certain channels over time among the members of a social system or communities [2].

Extension workers along with their supporting agencies make decisions at the community and national levels on how the strategies are implemented [3]. They are involved in the different facets of programs including planning, identifying resources, implementing activities, monitoring and evaluation, and reporting of their progress. Apart from making decisions, extensions workers are considered both change agents and opinion leaders in places they dwell, and thus, capable of influencing the adoption of new strategies, practices, and technologies among individuals in their communities [4].

Many organizations focus on building their capacity by training community extensions workers in the different development areas such as sustainable agriculture, sanitation and hygiene, women empowerment which are likely associated with household food and nutrition security. However, the extent to which these basic concepts are effectively acquired and practiced by agents and further transferred to end beneficiaries is a significant gap and requires further study. This is partly attributed to the lack of a validated questionnaires. Acquiring basic knowledge informs program evaluators on the effectiveness of nutrition education interventions, cements the first step in understanding innovations, and brings individuals closer to behavior change [2]. Basic nutrition knowledge is defined as "knowledge of concepts and processes related to nutrition and health including knowledge of *diet* and *health*, *diet* and *disease*, *foods* representing major *sources of nutrients*, and *dietary guidelines* and *recommendations* [5].

From a review of the current literature, there is hardly any study that has evaluated nutrition knowledge of extension workers in Uganda or even in Sub-Saharan Africa by applying valid pyschometric tools that include at least two of the nutrition knowledge concepts. In the guidelines

to develop and validate nutrition knowledge instruments [6], it is recommended to adapt a validated questionnaire that includes at least two of the above concepts. Therefore, as the first step to determining the nutrition knowledge of extension agents, in this Chapter the author describes studies aimed at evaluating validity and reliability the general nutrition knowledge questionnaire (GNKQ) initially validated for head teachers [7] to assess nutrition knowledge in a sample of community extension agents in Uganda. This study contributes to the process of validation of a general nutrition knowledge questionnaire for adults in Uganda and results were used to demonstrate the external validity of items beyond its application on head teachers.

5.2 Methods

Subjects. Forty-six extension agents (also known as innovation platform members) working with Bioversity International in Kiboga and Kyankwanzi districts were selected. The innovation platform members included businessmen, prominent farmers, Parish chiefs, religious leaders, teachers, village health team (VHT) members, health workers, and district leaders (counselors and local council chairmen). Their role was mainly to disseminate agricultural, health and nutrition information provided by the government, Bioversity International, and other development partners of the CGIAR Consortium of International Agricultural Research Centers. Also, thirty-four extension agents who were not working with Bioversity International or organizations in the CGIAR Consortium with the similar employment characteristics were included in this study. All extension agents were adults (18-74 years), of both sexes (55% female).

Enumeration. Two enumerators along with the author collected all the data. The author trained the enumerators in two sessions lasting four hours each. During these sessions, the author explained the goal of the study, the research activities, and the role of each enumerator. The enumerators scheduled the time for visiting the extension agents. Most of the extension agents met individually at their offices with the investigators. Their offices were near the respective district town councils. The enumerators read the consent form, answered any questions, and asked the extension agents to sign the consent form before providing the questionnaires. Enumerators left the surveys with the agents to fill out and picked them up at the end of the day. They collected the completed surveys and checked the forms for missing data before leaving the field. If missing information was found, enumerators asked the agents to address missing fields.

Ethical approval. Study protocols were reviewed and approved by the Institutional Review Board at the University of Illinois (IRB#15469) and the Uganda National Council for Science and Technology (No. SS 3700). All subjects signed a written consent before participation.

Procedures. The purpose of this study was to ascertain internal consistency and test-retest reliability of the items in the General nutrition knowledge questionnaire (GNKQ) for adults in Uganda [7] when administered to the community extension agents. The study also sought to determine the levels of nutrition knowledge among community extension agents. Community extension agents individually completed the GNKQ at their offices. All subjects completed the same questionnaire after two weeks. The GNKQ consisted of five domains of nutrition knowledge: *Expert recommendations, Food groups, Selecting foods, Relationship of nutrition and disease,* and *Food fortification* representing 137 items. The questionnaire contained other sections on sources of nutrition information and demographic characteristics. All the nutrition knowledge items were checked on whether participants had filled them before leaving the field. The participants were required to fill out all the questionnaire and potential missing questions before handing over the questionnaire.

Scoring. All data were exported to the Statistical Package for Social Sciences (SPSS v23.0, IBM Corporation, Armonk, NY) for scoring and analysis. Right answers were assigned one point and wrong ones or unsure responses no points, representing a maximum score of 137 points for nutrition knowledge. Other sections (i.e., sources of nutrition information and demographics) were not scored. The indices detailed below were calculated as described elsewhere [8,9].

Analyses. Data from all subjects were used to ascertain item difficulty, item discrimination, internal consistency, and test-retest reliability as explained earlier [7]. *Item difficulty* was evaluated using benchmarks provided earlier [7], in which acceptable items were answered correctly by 10 to 90% of the respondents. The items out of this difficulty range were removed from the analysis. *Item discrimination* or the ability for each item to discriminate between people with different levels of knowledge was evaluated using item-to-total correlation coefficient. Items with an ICC (r) lower than 0.2 were removed from the analysis. *Internal consistency* refers to the extent to which all items in the scale measure the same attribute. Cronbach alpha (α) was obtained from dichotomised (correct = 1, wrong or unsure responses = 0) values using SPSS23. Nutrition knowledge domains and the whole GNKQ with $\alpha > 0.7$ were considered with adequate internal consistency. *Test-retest reliability* demonstrates that the results produced are consistent over time.

Extension agents' scores obtained in a span of two weeks were used in this estimation. Paired t-test and intraclass correlations (ICC) on the total scores of each domain were calculated as in another study [9]. A single measure of the ICC, two-way random, absolute agreement ($ICC_{2,1}$) using a procedure described in a previous study [10] was applied. The acceptable test-retest reliability was an ICC ≥ 0.7 [9]. Total mean nutrition knowledge scores of the two extension agent groups were separated using Mann-Whitney U since data distribution were non-normal. Results for correct answers were converted to percentages with the maximum scores as the denominators.

5.3 Results

Subject characteristics, internal consistency, and test-retest reliability. Characteristics of the participants are presented in Table 5.1. Results of internal consistency and test-retest reliability are presented in Table 5.2. The internal consistency and test-retest reliability of the whole questionnaire before and after deleting items based on item difficulty and discrimination were considered acceptable.

After removing of items from analysis using the criteria of item difficulty and discrimination, the internal consistency for the first and second round of surveys were: knowledge of *Expert recommendations* (α = 0.73 and 0.72), "*Food groups*" (α = 0.85 and 0.88), "*Relationships of nutrition and diseases*" (α = 0.77 and 0.70), "*Food fortification*" (α = 0.90 and 0.88). However, the entire "*Selecting foods*" section was eliminated during analysis because the internal consistency (α) was below 0.7 and there were no items with acceptable item difficulty and discrimination.

For all participants, the internal consistency of the first and second round of surveys and before removing any items from analysis were: knowledge of *Expert recommendations* (α = 0.69 and 0.68), *Food groups* (α = 0.81 and 0.85), *Relationship of nutrition and disease* (α = 0.63 and 0.63), *Food fortification* (α = 0.90 and 0.88), and *Selecting foods* (α = 0.24 and 0.26), respectively. Fifty-two items were removed from analysis because of poor item difficulty and discrimination. Therefore, eighty-five items were used for analysis.

Table 5.1. Demographic characteristics of community extension agents in Kiboga and Kyankwanzi districts.

Characteristic		*On the Program*[1]		*Not on the Program*		*All*	
		n	***%***	***n***	***%***	***n***	***%***
Gender							
	Male	19	41.3	17	50.0	36	45
	Female	27	58.7	17	50.0	44	55
Age							
	18-24	3	6.5	8	23.5	11	13.8
	25-34	21	45.7	12	35.3	33	41.3
	35-44	12	26.1	8	23.5	20	25.0
	45-54	7	15.2	5	14.7	12	15.0
	55-64	2	4.3	1	2.9	3	3.8
	65-74	1	2.2	0	0.0	1	1.3
Education							
	Primary level	9	19.6	6	17.6	15	18.8
	Ordinary Secondary school	17	37.0	8	23.5	25	31.5
	High School (A' level)	1	2.2	6	17.6	7	8.8
	Technical college	9	19.6	5	14.7	14	17.5
	Diploma	4	8.7	2	5.9	6	7.5
	Degree	6	13.0	7	20.6	13	16.3
Number of children							
	None	6	13.0	10	29.4	16	20.0
	1	6	13.0	6	17.6	12	15.0
	2	9	19.6	3	8.8	12	15.0
	3	6	13.0	4	11.8	10	12.5
	4	4	8.7	6	17.6	10	12.5
	≥ 5	15	32.6	5	14.7	20	25.0
Do you have any nutrition-related qualification							
	Yes	14	30.4	6	17.6	20	25
	No	32	69.6	28	82.4	60	75

[1]Extension agents on the program (i.e., Bioversity International).

The test-retest reliability for items in the constructs on *Expert recommendations*, *Food groups*, *Relationship of nutrition and disease* and *Food fortification* were acceptable (ICC ≥ 0.7) before and after removing items with unacceptable item difficulty and discrimination, and internal consistency from analysis (Table 5.2). The knowledge domain of "*Selecting foods*" had unacceptable test-retest reliability (ICC < 0.7) before and after removing unacceptable items from analysis. There were no differences ($p < 0.05$) in scores at time one and two using paired *t*-test (Table 5.3).

Table 5.2. Internal consistency and test-retest reliability of the items in the GNKQ before and after deletion of items based on item difficulty and discrimination.

Topic on general nutrition	***Internal consistency (α)***						***Test-retest reliability (ICC)***	
	Before removing items			*After removing items*			*Before*	*After*
	Items	*Time 1*	*Time 2*	*Items*	*Time 1*	*Time 2*		
Expert recommendations	16	0.69	0.68	10	0.73	0.72	0.83	0.84
Food groups	67	0.81	0.85	44	0.85	0.88	0.83	0.86
Selecting foods	10	0.24	0.26	0			0.41	
Relationship of nutrition and disease	22	0.63	0.63	9	0.77	0.70	0.74	0.86
Food fortification	22	0.90	0.88	22	0.90	0.88	0.78	0.78
Total	**137**	**0.91**	**0.91**	**85**	**0.93**	**0.93**	**0.88**	**0.90**

Intra-class correlation (ICC) obtained for scores of each topic and overall.

Table 5.3. Nutrition knowledge scores before and after deleting items for all extension agents.

Topic on general nutrition	***Before removing items***					***After removing items***				
		Time one		*Time two*			*Time one*		*Time two*	
	Items	Mean	SD	Mean	SD	Items	Mean	SD	Mean	SD
Expert recommendations	16	9.30	3.00	9.61	2.85	10	6.74	2.45	6.93	2.38
Food groups	67	36.0	8.53	36.25	9.72	44	25.5	7.77	25.78	8.56
Selecting foods	10	3.64	1.59	3.71	1.59	0				
Relationship of nutrition and disease	22	5.93	2.92	6.73	2.98	9	4.06	2.41	4.54	2.16
Food fortification	22	5.95	5.47	5.93	5.14	22	5.95	5.47	5.93	5.14
Total	**137**	**60.9**	**17.0**	**62.2**	**17.3**	**85**	**42.2**	**14.7**	**43.16**	**14.61**

All means at time one and two (M) were not significantly different (P > 0.05) using paired t-test. SD- Standard deviation of the scores.

Nutrition knowledge scores. The nutrition knowledge scores of all extension agents are reported in Table 5.4. There were no differences in nutrition knowledge scores between extension agents working with and not working with Bioversity International in all four knowledge domains with acceptable reliability: *Expert recommendations* ($U = 690$, $p = 0.365$), *Food groups* ($U = 730$, $p = 0.612$), *Relationship of nutrition and disease* ($U = 765.5$, $p = 0.871$), *Food fortification* ($U = 728.0$, $p = 0.591$), and *Total nutrition knowledge score* ($U = 770.5$, $p = 0.911$).

Table 5.4. Nutrition knowledge scores of extension agents characterized (round one).

Characteristic	*On the program*			*Not on the program*			
	n	***mean***	***SD***	***n***	***Mean***	***SD***	***p-value***
Gender							
Male	19	48.00	14.87	17	42.41	16.67	$p > 0.05$
Female	27	37.67	13.49	17	42.88	13.24	$p > 0.05$
Have Nutrition related qualification							
Yes	14	37.30	16.11	6	48.33	16.71	$p > 0.05$
No	35	43.14	16.53	27	42.19	12.54	$p > 0.05$
Level of education							
Primary	9	25.89	7.96	6	40.00	16.01	$p < 0.05$
Secondary	18	40.11	10.92	14	35.93	13.48	$p > 0.05$
Tertiary	19	51.26	13.61	14	50.50	13.00	$p > 0.05$
Sources of nutrition information							
At school	31	43.32	15.93	23	44.04	16.16	$p > 0.05$
Peers and friends	21	44.38	15.32	17	49.35	14.97	$p > 0.05$
Health personnel	35	42.91	13.70	27	44.19	14.46	$p > 0.05$
Parent/Guardian	27	43.48	14.20	16	45.31	15.23	$p > 0.05$
Books and magazines	34	42.88	15.41	23	45.44	15.65	$p > 0.05$
Internet	17	42.12	14.32	24	43.38	15.06	$p > 0.05$
Total	**46**	**41.94**	**14.83**	**34**	**42.65**	**14.82**	$p > 0.05$

Nutrition-related qualification included week-long trainings, workshops, and short-term courses on nutrition. None of the respondents had a degree or diploma certificate in Human nutrition.

***Demographic differences in nutrition knowledge*.** The mean scores of the male participants were higher although not significant ($P > 0.05$) than those for the female agents for all the knowledge domains (Fig. 5.1). Out of the maximum score of 85, the mean score was 42.24 (SD 14.74). The score of male respondents was 45.4 (SD 15.77), while that of female respondents was 39.68 (SD 13.45).

There was a significant difference in total nutrition knowledge scores among participants with different education attained, i.e., from primary to tertiary (F [1, 78] = 28.23, $p < 0.001$) (Fig. 5.2).

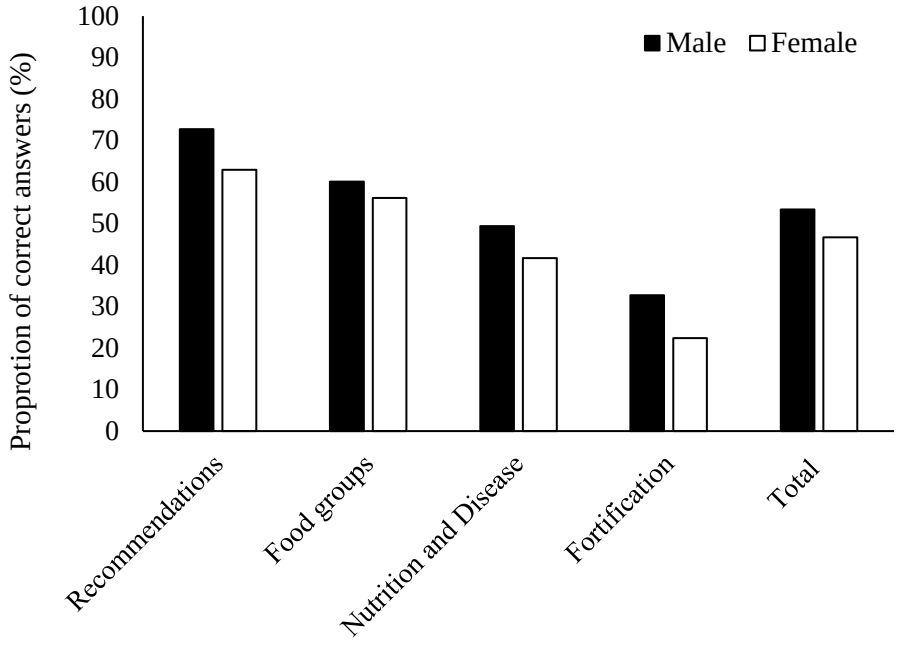

Fig 5.1. Proportion of correct responses among male and female respondents after the first round of the GNKQ.

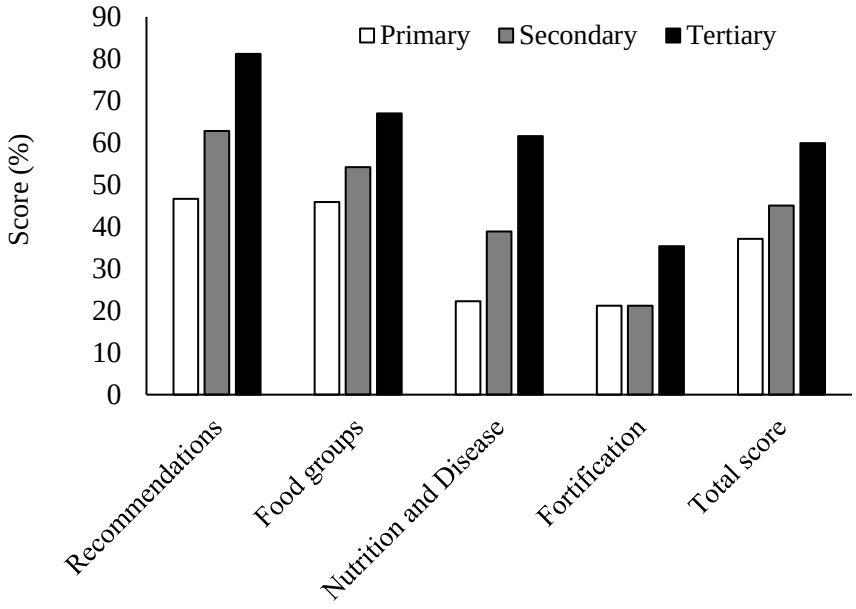

Fig. 5.2. Knowledge level across maximum education attained by community extension agents.

5.4 Discussion

In a previous study, data obtained using the general nutrition knowledge questionnaire (GNKQ) was found to be valid and reliable to evaluate nutrition knowledge among adults (i.e., head teachers) in Uganda [7]. Apart from head teachers, extension agents are another group of adults in Uganda that are continually trained in different concepts in nutrition and regarded as key players in the implementation nutrition programs in communities [11]. As with head teachers, evaluation of nutrition knowledge of other influential community members is an important aspect of their training to facilitate their role and for monitoring and evaluation purposes.

Adequate knowledge is important to identify, capture, share, reframe and recodify new knowledge of the innovation [12]. Also, a World Bank study [13] provided action points to improve nutrition in schools and communities. Training of community members on basic concepts on nutrition including food values, food fortification and food hygiened were empasized. Such training interventions require improved evaluation of nutrition knowledge. Evaluation of nutrition knowledge of community extension agents or even any other groups, requires valid tools to collect quality data [6]. This study provided evidence that the GNKQ developed earlier [7] could be applied to obtain valid and reliable data on nutrition knowledge from community extension agents, demonstrating its external validity.

Several knowledge domains i.e., *Food groups, Relationship of nutrition and disease* and *Food fortification,* and *Expert recommendations* had questionable to acceptable internal consistency ($\alpha \geq 0.6$-0.9) before removing any items with poor item discrimination. After removal of items with poor difficulty and discrimination, all items in the *Selecting food*s section still showed very poor internal consistency, and thus the whole section was removed from further analyses. The other knowledge domains had acceptable internal consistency ($\alpha \geq 0.7$), however with lesser items in each of them. Overall, after edition, the final results (85 items) on internal consistency and test-retest reliability were similar to those reported in other studies [7-9, 14]. Some of these studies, however, did not report the baseline internal consistencies and test-retest reliabilities to evaluate progression from one draft to another, and thus, enabling a fair comparison of these results.

The section on *Selecting foods* consistently had unreliable items as in Chapter 4 and our previous study [7]. A similar questionnaire was used in the United Kingdom (UK) to evaluate general nutrition knowledge, and the data on this domain had acceptable reliability [8]. Low

knowledge in selecting foods based on nutrition needs i.e. difficult items [6, 15], may explain the low reliability in the Uganda sample. Nutrition education of adults and, especially of educators focusing on imparting skills to select food items based on nutrition needs is not a priority in Uganda [16]. The lack of focus on nutrition education might have contributed to the poor knowledge levels in the domain of *Selecting foods* which is related to food choices. Also, as reported in an earlier review [15], characteristics such as sample size, and fewer items than in other domains cause enough variation in results leading to low reliability. Unacceptable reliability on this same domain of *Selecting food*s was reported in another study that used some of the similar items on an adult population in Norway [17]. In this study, the authors were focused on developing a tool to evaluate nutrition knowledge in obese adults. Authors included food choices and obtained internal consistency ($\alpha = 0.51$) and test-retest reliability ($r = 0.64$), which are below the acceptable benchmarks. They attributed the low internal consistency to very intricate or very simple items that may fail to not differentiate between actual knowledge of individuals.

Reliability results from the domain on "*Expert recommendations*" were different than those presented in Chapter 3 and 4 on head teachers. Both internal consistency and test-retest reliability values were above the benchmarks. This is partly explained by the differences in the sample characteristics. Previous authors have suggested that reliability of items is sample specific [6, 15]. Another factor that may explain these results is the difference in the level of education and training [15]. More extension agents had agriculture and nutrition related training more so than head teachers (25% vs. 11.8, χ^2 (1) = 8.4, $p = 0.004$), which may explain their acquaintance with the items in the "*Expert recommendation*" section. These results replicate those obtained in a study aimed at evaluating the Parmenter and Wardle's questionnaire [8] in a sample (n =116) of community adults and students in Australia [14]. It is possible that the lack of reliability on items in "*Expert recommendations*" found in the previous study with head teachers is due to the limited dissemination of nutrition policies and guidelines in schools [13], which might have contributed to poor item difficulty values. About 60% of health policies coming from all the Ministries located in Kampala are not available at the service delivery level [18]. Therefore, it is possible that poor access to information on nutrition policies in the case of head teachers compared to community extension agents might have lowered their awareness of such nutrition guidelines.

The nutrition knowledge scores of the extension agents working with and those not working with Bioversity International were not different (41.94 ± 14.83 vs. 42.65 ± 14.82; $p >$

0.05). This was expected as the sampling did not take into account the type and intensity of training provided to extension agents. The innovation platform members working with Bioversity International lived and worked in the same area as other community extension agents in Kiboga and Kyankwanzi districts. Therefore, it is very likely that agents from both groups have worked on similar projects under the auspice of the same development partners in the past. Although a significant proportion of these extension agents receive training, especially in nutrition, their performance was lower than 50% of the total score. In these populations, no formal evaluation using valid tools has been documented.

There were a few limitations in this study. The study recruited an heterogeneous sample of community extension workers. The sample was characterized using a wide range of social demographic indicators such as education levels, age (18 to 74 y), and the number of children (0 - >4). This may have impacted the reliability results. Future studies need to consider these characteristics to arrive at the adequate sample size with sufficient power to identify small differences associated with these categories. The questionnaire should be used on extension agents cautiously as nutrition knowledge collected may not imply that they are better at training on nutrition concepts and practices. Future studies can use the questionnaire to evaluate nutrition knowledge in studies exploring nutrition knowledge as a factor influencing nutrition information dissemination among community extension agents.

5.5 Conclusion

The general nutrition knowledge questionnaire that was earlier developed [7] to evaluate nutrition knowledge among head teachers in Uganda had items that provided reliable data by using a sample of community extension agents. Nonetheless, items on *Selecting food* yielded knowledge data with unacceptable reliability, results which are incosistent with those presented in Chapters 3 and 4 with head teachers. Unlike the reliability results with head teachers, items in the domain on *Expert recommendations* yielded reliable nutrition knowledge data of extension agents. The reliability of data using the GNKQ requires further evaluation potentially by administering the questionnaires to a larger sample of extension workers in Uganda. Therefore, the general nutrition knowledge questionnaire earlier validated [7] can be applied to collect valid and reliable nutrition knowledge data from different adult populations in Uganda. The data on nutrition knowledge

obtained from the community extension agents could serve as a baseline for future nutrition education interventions.

5.6 References

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CHAPTER 6: NUTRITION KNOWLEDGE OF HEAD TEACHERS INFLUENCES ADOPTION OF GUIDELINES ON SCHOOL FEEDING AND NUTRITION INTERVENTION PROGRAMME

Abstract

This study explored basic nutrition knowledge of head teachers as one of the factors that influence adoption of the Uganda Guidelines on School Feeding and Nutrition Intervention Program (GSFNIP). The Diffusion of Innovation framework guided on the design, summary, and conclusions of this study. Adoption variables: awareness scores and implementation levels were generated from GSFNIP. Head teachers' nutrition knowledge was evaluated using the questionnaire previously developed (Chapter 4). School demographics and organizational environment as well as head teachers' personal characteristics were obtained. Correlation analysis, multiple linear regression and logistic regression analyses explored relationships among variables. Nutrition knowledge correlated with awareness scores (r = 0.2, p < 0.01), but not with implementation levels (r = -0.04, p > 0.05). The multiple regression models had a large strength for *awareness score* (*Adjusted* R^2 = 0.42, F [12, 186] = 13.12, *MSE* = 2.9, p < 0.001) and *implementation levels* (*Adjusted* R^2 = 0.30, F [9, 189] = 10.4, *MSE* = 694.5, p < 0.001) as dependent variables. Nutrition knowledge was a significant predictor (β = 0.158, p = 0.006) of increased awareness on GSFNIP. Awareness instead was a significant predictor of implementation levels (β = 0.246, p < 0.001). Nutrition knowledge was not a predictor of implementation levels (β = -0.032, p = 0.621). The logistic regression of school meals on similar variables was adequate and significant (Nagelkerke R^2 = 0.25, χ^2[10] =37.4, p < 0.001). *Awareness score* (e^b= 1.22, p = 0.033), but not *nutrition knowledge* (e^b = 1.00, p > 0.05) was a predictor of availability of meals at schools. Results suggest that head teachers' nutrition knowledge influenced adoption of GSFNIP by increasing their awareness. Future nutrition interventions should consider improving nutrition knowledge of head teachers before their inception in schools.

6.1 Introduction

A recent World Bank study reported that despite efforts of improving nutrition among school-age children, there has been limited progress [1]. The study revealed that 40% of the rural primary schools do not have school meal programs. Moreover, those schools that have school-meal programs provide limited amounts of fruits, vegetables, and fortified foods to children. The Uganda Guidelines on School Feeding and Nutrition Intervention Program (the Guidelines) were released in early 2015 [2]. The Guidelines promote the implementation and provide standards for harmonization of school feeding programs with a goal of improving the quality of life and cognitive performance of all school-age children including those in primary schools (6-12 years). The Guidelines describe the operationalization of activities around the following areas: parent and community involvement, school feeding options, nutrition care and complementary practices, and nutrition education. An important aspect associated with the implementation of these guidelines is that schools do not have to adopt them unless there is significant support from the school system stakeholders, i.e., parents, students, teachers, and the community. Therefore, it is critical to understand the factors that influence adoption of these Guidelines as well as to evaluate the effectiveness of their implementation.

Factors that influence adoption of the school feeding recommendations can be well studied and organized using the Diffusion of Innovation theoretical framework. Rogers popularized the framework in his book, *Diffusion of Innovations* first published in 1962, as he sought to explain why, how and at what rate agricultural innovations diffuse in rural farming societies [3]. Greenhalgh and colleagues define innovations as a set of behaviors, routines, and ways of working directed at improving health outcomes, administrative efficiency, cost effectiveness, or users' experience and are implemented by planned and coordinated actions [4]. Moreover, diffusion is the passive spread of the innovation into adoption, largely by imitation. According to Rogers, in an organization the process of adoption starts with appearance of the innovation, its awareness and decision to adopt it, followed by implementation and finally institutionalization (Fig. 1.3). In an extensive systematic review (>1000 articles), several factors influencing the spread and sustained implementation of innovations in health service delivery and organizations were explored [4]. These can be summarized into adopter characteristics, perceived attributes of the innovation, and organizational and inter-organizational characteristics. Interestingly, this group argues that too few studies address personal characteristics (e.g., knowledge and experience) of key adopters (e.g.,

managers, group leaders), which could influence the adoption of the innovations to the whole organization or by discrete groups.

Deschesnes and colleagues examined a prediction model that integrated the three categories of predictors likely to influence adoption of the Quebec Healthy Schools approach, namely: attributes of the approach, subjects' characteristics, and organization context characteristics [6]. Results showed that school organizational characteristics such as the presence of leaders within schools, perceived school contextual barriers, school investment in healthy lifestyles, and beliefs in collective efficacy had more weight in influencing the adoption of this program [6]. This group concluded that traditional attributes on innovation characteristics such as relative advantage, compatibility, complexity, trialability, and observability are not the strongest determinants to explain health program adoption in schools [6]. Also, they reported that the presence of leaders within the school and knowledge of the health innovation were better predictors of health program adoption. Nonetheless, this group did not fully explore the knowledge of these leaders, professional or technical, beyond awareness of the innovation. In Uganda, no studies have explored nutrition knowledge of key change agents (e.g., head teachers) within organizations (e.g., schools) as a factor influencing the adoption of recommended practices (e.g., Guidelines).

Head teachers are central in the communication pathway between government officials and members of the school community including parents, teachers, and students [7]. They are expected to use their knowledge (e.g., management, nutrition, etc.) and experience to interpret the current Guidelines, and then, persuade other members of the school community to start and sustain a school feeding program. Even though knowledge of nutrition among head teachers and school community, among several other factors, may influence the establishment of a feeding program and the adoption of current Guidelines, there is no evidence to support it.

In this Chapter, the relationship of head teachers' nutrition knowledge together with the organizational and physical characteristics of schools as potential variables that influence adoption of these Guidelines in Uganda is explored. For this, the author uses the Diffusion of Innovation framework as reviewed by Greenhalgh and colleagues [4] and applied by Deschenes and colleagues [6] to explain the adoption of the Guidelines in schools. The working hypothesis is that head teachers' nutrition knowledge along with other personal and school environment characteristics influence the adoption of these Guidelines (Fig. 6.1). The current study builds on previous studies on adoption of health programs in school settings with the *aim of exploring*

nutrition knowledge of head teachers as a factor that influences adoption of the Guidelines on School Feeding and Nutrition Intervention Program.

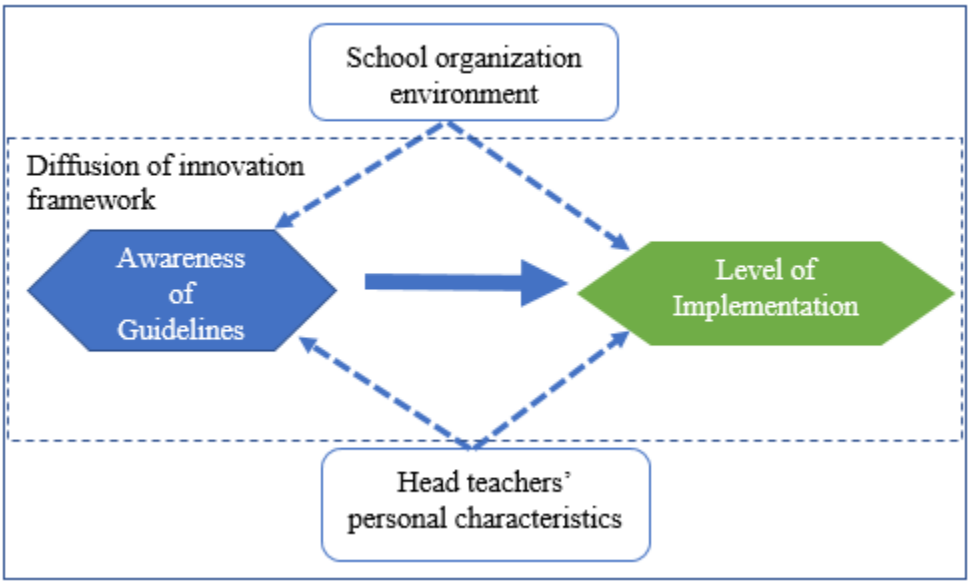

Fig 6.1. A conceptual framework to explain the impact of variables associated with school organization context and head teacher's personal characteristics on the adoption of Uganda's Guidelines on School Feeding and Nutrition Intervention Program.

6.2 Methods

Population and sample size calculation

The study recruited the same sample of head teachers from Mukono and Wakiso Districts as reported in Chapter 4. The characteristics of the head teachers and schools were reported in Chapter 4 and presented in Tables 6.1 to 6.3. Final models were obtained using the framework for the relationships among the 25 variables included in this study (Fig. 6.1). In this study target effect size of $R^2 = 0.15$ (medium), random error (5%) and power (95%) yielded a total sample size of 222 schools/ head teachers after computing using G-Power software [8]. A total of 218 head teachers filled all the sets of questionnaires (1-3) in section 6.2.3. However, during analysis the final regression models relating awareness scores, implementation levels and availability of school meals as dependent variables and school and head teacher characteristics as independent variables used data of 199 head teachers/schools after removing the missing data. The sample size used in the final regression models was adequate as final R^2 (0.42, 0.3, 0.25) for awareness (on 12

variables), implementation levels (on 10 variables) and availability of school meals (on 10 variables) on school and head teacher characteristics yielded sample sizes of 73, 91 and 97, respectively. Therefore, data from a sample of 199 individuals and schools used in the regression analyses was adequate after removing missing data. All computations used error rate of 0.05 and power of 95%.

Variables

A systematic review by Greenhalgh *et al.,* (2004), presented several factors that are related to adoption of innovations including innovation characteristics, adopters' characteristics, social influence, organizational and inter-organizational context. These characteristics are summarized in Chapter 2 of this dissertation. In this Chapter, the author focuses on the personal and school characteristics. *Personal characteristics* include nutrition knowledge (*prior knowledge*), teaching, and administration experiences of head teachers (*professional experience*). The school demographic and organizational characteristics such as management and leadership style as well as parent and community support were included (Fig. 6.1). *Demographic characteristics* such as location (rural vs. urban), school population (registered number of students), and the level of education of teachers (qualified and non-qualified) were obtained. The *management and leadership* attributes included were perceived head teachers' school climate, school management practices, professional development, and school planning. The *parent and community support* included parent involvement and school support for parent involvement in school activities.

Table 6.1. Demographic characteristics, ownership status, and availability of school meals of the selected schools.

Characteristic of selected schools	***n***	**% or mean±SD**	***t*/ χ^2 (*df*) *p*-value**
Ownership (N= 218)			
Government	117	53.7	
Private	101	46.3	
Location (N = 218)			
Rural	100	45.9	
Urban	118	54.1	
Distance of the school from Kampala (km)			
Rural	98	30.0 ± 19.1	-3.4 (210),
Urban areas	114	19.0 ± 26.7	p = 0.001
Government	115	30.0 ± 29.1	-4.1 (210),
Private	97	17.0 ± 13.4	p = 0.005
Availability of school meals (*N* =218)			
Rural	63	63.0	$X^2(1)$= 5.9,
Urban areas	92	78.0	p = 0.015
Government	76	65.0	X^2 (1) = 4.7,
Private	79	78.2	p = 0.031
All schools	155	71.1	
Qualified teachers			
Rural	95	10.4 ± 8.4	3.4 (208),
Urban	114	14.3 ± 8.1	p = 0.012
Government	116	13.5 ± 9.7	-1.7 (208),
Private	94	11.5 ± 6.3	p = 0.078
Total number of teachers			
Rural	99	12.0 ± 7.9	2.3 (215),
Urban	118	17.1 ± 20.9	p = 0.042
Government	117	16.0 ± 21.4	-1.1 (215),
Private	100	13.5 ± 5.8	p = 0.265
Average number registered students			
Rural	100	371 ± 256	0.9 (214),
Urban	116	406 ± 318	p = 0.37
Government	116	478 ± 296	-5.08 (214),
Private	100	287 ± 249	p< 0.001
Average years of existence of the school			
Rural	95	43.1 ± 29.5	-3.7 (206),
Urban	113	28.4 ± 28.0	p < 0.001
Government	114	55.5 ± 24.9	-17.2 (206),
Private	94	10.2 ± 6.6	p < 0.001

Uganda Bureau of Statistics defines an urban area as gazetted cities, municipalities and towns with a population of 2,000 people or more [9]. Otherwise, the places that do not fit this definition will be categorized as rural areas. SD, Standard deviation

Instruments

To obtain data on the several variables, four questionnaires were administered to head teachers: 1) Recommended school feeding practices, 2) head teachers' awareness of Guidelines, 3) School organizational context (Appendix 3) and, 4) GNKQ used in Chapter 4. Unlike the nutrition knowledge questionnaire that was administered twice within a two-week period, the other set of questionnaires (1-3) were administered once at the second visit.

1. **The school organization environment questionnaire (Appendix 3).** The items in the Namibia School Improvement Program School Self-Assessment [10] were reviewed to align with the realities of the Ugandan schools to obtain the items associated with school leadership and management practices. The final questionnaire comprised of 67 items divided into the following sections: School climate (11 items), School management practices (10 items), Professional development (10 items), School Planning (6 items), School support for parent involvement (7 items), Involvement of parents in school activities (13 items), and School materials (10 items). The definitions of the composite variable with examples of items used are provided in Table 6.2. A scale of 1 to 4 was used to query reviewers' agreement, in which the nominal values were Strongly disagree (1), Disagree (2), Agree (3), and Strongly agree (4) [10]. Scores were obtained as explained in previous studies [11, 12]. Briefly, the scores of items in each section were summed up to generate composite scores for school climate, school management practices, professional development, school planning, school support for parent involvement, the involvement of parents in school activities, and school materials (Table 6.3). Also, the questionnaire included school demographic characteristics such as year of establishment used to compute years of existence with 2016 as the reference year, the number of teachers and other staff members, distance from Kampala, and student performance (i.e., results of the schools for 2015 Primary Leaving Exams (PLE), a national exam taken by students at the end of seven years of primary school level to join secondary school).

2. **Recommended school feeding practices (Appendix 3).** The GSFNIP [2] were reviewed to obtain the various recommended school feeding and nutrition practices and generate items for the questionnaire. Fifty-four items were generated from practices recommended in the Guidelines. The following nominal response scale was used: Not in place (1), Under development (2), and Fully in place (3). In addition, a food availability score was created. This

score consisted of the number of food items, as recommended in the Guidelines, present in storerooms or available at schools (Appendix 3). The list of 31 food items in the guidelines is provided in appendix 3. Head teachers were asked, "Do you have … in the school store or available to the school?" A nominal scale of Yes, food is available in store (1), and No, food is not available in store (0) was used. The scores on items were summed up to obtain the overall composite score for *food availability* and the *recommended school feeding, and nutrition practices* using procedures explained in other studies [11, 12]. The *degree of implementation* was the sum of food availability score and the recommended school feeding and nutrition practices scores (Table 6.3). The implementation level represents the recommended activities described in the Guidelines within four broad areas including 1) school feeding and meals, 2) involvement of stakeholder from community and school, 3) nutrition care and complementary practices, and 4) integrated nutrition education [2].

3. **Personal characteristics and awareness of Guidelines (Appendix 3).** The questions on awareness of the guidelines were included. Awareness items from another study [5] were adapted to suit the GSFNIP. A nominal scale consisting of three scores Not aware (1), True (2), and Not true (3) was used. During statistical analysis, the results were dichotomized into Not aware (0) and Aware (1). The total sum of the scores was the awareness score [5]. Also, the questionnaire included items on sources of information and frequency of use of such sources. For frequency of use, a nominal scale of 1 to 4 representing Never (1), Sometimes (2), Often (3), and Always (4) was used to score the answers. For access to information sources, the nominal scale to tabulate responses was either Yes (1) or No (0). The sources of information included the Uganda Food and Nutrition Policy, Uganda Nutrition Action Plan, the GSFNIP, the Internet, magazines, and food labels. During statistical analysis, the scores on the frequency of use of all sources were reassigned into a scale representing Never (0), Sometimes (1), Often (2) and Always (3) and values were summed up to generate the frequency of use score. Other variables such as experience (in years) of the head teacher performing as a head teacher and as a teacher were also obtained.

   For questionnaires 1 to 3, twenty head teachers from Kampala reviewed the questionnaire to assert content and face validity of items. The items with an acceptable item-to-total correlation of $r \geq 0.2$ and the whole scale with internal consistency $\alpha \geq 0.7$ were used to generate the scores

and included in analyses (Table 6.3). All data were entered in Statistical Package for Social Sciences (SPSS v23.0, IBM Corporation, Armonk, NY, USA).

4. **General nutrition knowledge (Appendix 2).** The nutrition knowledge questionnaire previously developed and validated [13] was administered to head teachers using the procedure explained in Chapter 4. Only items with acceptable item-to-total correlation, $r \geq 0.2$ from three sections on nutrition knowledge (Food groups, Relationship of nutrition and disease, and Food fortification) with acceptable internal consistency ($\alpha \geq 0.7$) and test-retest reliability using intraclass correlation coefficient (ICC ≥ 0.7) were used to generate nutrition knowledge score. Details on nutrition knowledge of head teachers are reported in Chapter 4.

Enumeration. The enumerators who were trained in Chapter 4 along with the author collected the data. The enumerators were involved in contacting the selected head teachers and schedule the time for visiting the schools. Each day, schools were marked in a working map and a data collection route was created. The route was based on the shortest distances between schools to make data collection efficient. The enumerators were dropped at specific sites following this map. Then, at the schools, they went through the consent form and asked the head teachers to sign the consent form. After the head teachers signed the consent form, the enumerators provided the questionnaires to the head teachers and answered their questions. When schools were close to each other, ennumerators walked to the next school to administer the questionnaire. Enumerators left the surveys with the head teachers to fill and picked them at the end of the day. They collected the completed surveys and checked the forms for missing data before leaving the field. If missing information was found, enumerators asked the head teachers to address missing fields.

Human subject research compliance

The Institutional Review Board at the University of Illinois (IRB#15469) and the Uganda National Council for Science and Technology (No. SS 3700) approved all research protocols. District Education Offices of Mukono and Wakiso provided permissions to conduct studies. All subjects provided consent before participation.

Table 6.2. Definitions of variables and examples of items for school organization environment.

School Characteristic Definition	Examples of items in the questionnaire
School climate is widely defined as the shared perception on the ways things, or people around interact (for this case the school). More specifically, the climate is shared perceptions on organizational policies, and procedures, both formal and informal interactions etc. [14].	Respect of each other within; school confidence in students; acknowledge teachers and students; students confident in school; dedicated parents, teachers, and student; clean and orderly facilities; punctuality observed by teachers and students, etc.
Management practices include continuous monitoring of performance and improving processes, define the objective and have rigorous goals and reward system for high-performance employees and the correction of under-performing employees. It involves four major themes: operations, monitoring, target setting and people management [15, 16].	The school having a written and shared mission statement; clear standards of academic success; clear rules and regulations; apply rules and regulations fairly; school management committee (SMC) and head teacher shares goals, SMC does class visits; discipline procedures available; start class on time, etc.
Professional development consists of both formal (e.g. workshops, professional meetings and mentoring, etc.) and informal (such as reading professional publications, watching documentaries related to academic discipline, etc.) activities planned and implemented to equip and improve the knowledge, skills, competencies, and attitudes, of professionals after taking up their leadership roles [17, 18].	There are school and teacher meeting on subjects, performance; cluster meetings; teachers pursuing higher qualification; teachers seek support from others, etc.
School planning involves schools to develop the elements of strategic planning including vision, mission, goals, action plan, outcome measure, strategies for continuous improvement and evaluation [19].	There is a school development plan (SDP); teachers, parents, students, and head teacher are active participants of SDP; there is a school development committee to review SDP and regularly; SDP helps everyone to focus, etc.
Parental involvement is an integrative kind of thinking and approach to school an improvement where youths are educated effectively, with parents and families should become fully involved in the process of educating learners [20].	Parents are active members of Parents-Teachers Association; parents provided money or material resources; parents help and facilitate in school and classroom when called upon; parents ensure students attend and perform well in class; more than 20% of parents are involved etc.
School support for parent involvement is different activities at schools to encourage parents to participate in their children's learning process. For example, some schools provide questionnaires to learn of parents liking and dislikes [21]	The school has a schedule of parents' activities; school welcomes parents' involvement; the school has a regular system of communication with parents; there is a teacher-parent communication schedule etc.
School materials are resources that can help teachers and learners implement teaching and learning practice. This includes textbooks, newspapers, story books, desks, evaluation tools, videos, classrooms, libraries, and school facilities [22- 25].	The school has enough textbooks; textbooks are regularly supplied and on time; every teacher has a syllabus for each subject; classrooms have enough writing materials; the assistance for materials is received when planned for; the school receives special needs assistance; there are enough teaching aids; the school receives assistance in specialized services etc.

Table 6.3. Internal consistency of composite variables for school and head teachers.

School/ Head teachers' Characteristic *N* = 218	Internal consistency (α) Before (items)	Internal consistency (α) After (items)	Max score after internal consistency
Head teachers			
Awareness	0.75 (8)	0.90 (6)	6
Access to different sources of information	0.90 (6)	0.90 (6)	6
Frequency of use of sources of information	0.85(6)	0.85(6)	18
School			
School climate	0.74 (11)	0.89 (10)	40
School management practices	0.91 (10)	0.91 (10)	40
Professional development	0.86 (10)	0.86 (10)	40
School planning	0.90 (6)	0.90 (6)	24
School support for parent involvement	0.76 (7)	0.76 (7)	28
Involvement of parents in school activities	0.1 (13)	0.72 (5)	20
School materials	0.66 (10)	0.84 (8)	32
Recommended School feeding and nutrition practices score	0.87 (54)	0.92 (45)	135
Food Availability score	0.50 (31)	0.87 (21)	21

Before and after deleting items with acceptable item-to-total correction ($r \geq 0.2$). Max implementation levels (156) is the sum of recommended school feeding and nutrition practices score and food availability score.

Data analysis

Data mining. All data were entered into Statistical Package for Social Sciences (SPSS v23.0, IBM Corporation, Armonk, NY, USA). All reassigned scales explained in the previous sections was conducted after data entry. The framework [6] was adapted and informed by the results of a systematic review [4] and used to analyze and present the data (Fig. 6.1).

General hypothesis: It was hypothesized that personal characteristics, school organizational context characteristics and nutrition knowledge of head teachers were not associated and not predictors of adoption (adoption variables: awareness and implementation) of GSFNIP and availability of school meals.

Primary hypotheses: The following hypotheses were tested using techniques explained in the proceding sections. The Diffusion of Innovation framework [6] was used (Fig. 6.1) to summarize the relationship. Given the different variables in this study and the purpose of this study i.e. testing

whether nutrition knowledge was a predictor to the adoption of GSFNIP, the following primary null hypotheses were tested:

Correlation analysis

i) H_o: There was no relationship between nutrition knowledge and innovation decision process variable i.e. awareness.
ii) H_o: There was no relationship between nutrition knowledge and innovation decision process variable i.e. the degree of implementation of the Guidelines.
iii) H_o: There was no relationship between awareness score and the degree of implementation of the Guidelines.

Multiple linear regression

iv) H_o: General Nutrition Knowledge was not a predictor of Awareness score of GSFNIP.
v) H_o: General Nutrition Knowledge was not a predictor of implementation levels of GSFNIP.
vi) H_o: Awareness on GSFNIP was not a predictor of implementation levels of GSFNIP.

Logistic regression

vii) H_o: Knowledge was not a predictor of availability of school meals
viii) H_o: Awareness score on GSFNIP was not a predictor of availability of school meals

Statistical analyses. Descriptive statistics, means and standard deviations for variables collected from the three questionnaires are summarized in Table 5.1 and 5.3. Chi-square test was used to determine any associations between the categorical variables in the framework (Table 6.1).

1. Correlation analysis

Correlation analysis, i.e., using Pearson's correlation coefficient (*r*), was conducted between the variables with continuous scores with nutrition knowledge, awareness score, and implementation levels (Table 6.4).

2. Multiple regression analysis

Two multiple linear regression analyses were conducted using the procedure described in another study [26]. Multiple linear regression has the advantage of examining the association

between multiple covariates and a numeric outcome. Multiple linear regression enables to see through confounding and isolate the relationship of interest [27]. Normality and equality of variances of residual, and multicollinearity were tested.

Multiple regression 1: The head teachers' awareness scores were regressed onto the schools' organizational characteristics and head teachers' personal characteristics. Equation 1 explains the relationship between predictive and outcome variables in the multiple regression analysis. The final variables in the regression model are reported in Table 6.5.

$$Y = b_0 + b_1X_1 + b_2X_2 + \ldots + b_kX_k \qquad \text{(Equation 1)}$$

Where,

Y =	Awareness score
b_0, b_1 and b_k =	Estimate regression parameters
X_1 X_2 and X_k=	k predictors (head teachers' personal characteristics, general nutrition knowledge, and school organizational context)

Multiple regression 2: The degree of implementation of the guidelines was regressed onto head teachers' personal characteristics, schools' organizational characteristics, and head teachers' awareness score and general nutrition knowledge. Equation 2 explains the relationship among predicting and outcome variables. The final variables in the regression model are reported in Table 6.6.

$$Y = b_0 + b_1X_1 + b_2X_2 + \ldots + b_kX_k \qquad \text{(Equation 2)}$$

Where,

Y =	Degree of implementation of the Guidelines
b_0, b_1 and b_k =	Estimate regression parameters
X_1 X_2 and X_k=	k predictors (head teachers' personal characteristics, awareness of the Guidelines, general nutrition knowledge, school organizational context)

In these two multiple regression analyses, two models were tested (Table 6.5- 6.6), one without head teachers' general nutrition knowledge scores (model 1) as a predictor and another with

head teachers' general nutrition knowledge scores (model 2). It was posited that addition of nutrition knowledge scores as a predictor will lead to a significant improvement in the overall model to explain the dependent variables. *Multiple R, adjusted* R^2, *F (p-value)* and *MSE* were reported. The effect size classification suggested by Cohen (1988) was used to present the strength of R^2 [28, 29]. The strength of R^2 was classified as small, medium, and large when R^2 = 0.01, 0.09, and 0.25, respectively [29]. The residuals had equal variance and normality as observed from graphical outputs for the two multiple regression analyses [30]. Lack of multicollinearity was observed using collinearity diagnostics (VIF < 6, tolerance close/ larger than 1). Statistical significance was estimated at $p < 0.05$.

3. Logistic regression analysis

Logistic regression was used to establish the effect of head teachers' and school organizational characteristics on the availability of school meals. Like multiple linear regression, logistic regression can control for numerous confounders if the sample size is large enough [27]. The nominal scale of *No meals available* (0) and *Meals available* (1) was used to score the responses. The number of dummy variables was obtained from the number of category options minus one as explained elsewhere [30]. Table 6.7 provides the final variables obtained for the logistic regression model. The following regression equation adapted from elsewhere (Equation 3) was used to test the relation between the variables [30].

$$\log_e (E(Y)) = b_0 + b_1X_1 + b_2X_2 + \ldots + b_kX_k \qquad \text{(Equation 3)}$$

Where,

$\log_e$ =	Natural logarithm
(E(*Y*)) =	Expected value of response outcome – availability of school meals (0, 1)
b_0, b_1 and b_k =	Estimate regression parameters
X_1 X_2 and X_k=	k predictors (personal characteristics, awareness of Guidelines, nutrition knowledge, and the school organizational context)

The regression statistics were obtained and interpreted as explained earlier [30]. *Classification accuracy* gives information as to whether the model is better off with or without predictors. The benchmark for the classification accuracy of the model was computed from the squares of

the frequency proportions of the outcome (0, 1) x 1.25. The computed classification accuracy ($0.72^2 + 0.28^2$) was 0.75, which was lower than the obtained classification accuracy (78.9) in block one in the SPSS output indicating the model was better off with predictors. *Nagelkerke* R^2 is the proportion of variability in *Y* (availability of school meals) accounted for by a set of predictors [30]. The Chi-square (χ^2) test was used test the adequacy of the model. *Estimate Regression parameters* i.e. *logits*, Wald (*t-test* for logits*), odds ratios (OR),* and *intercept*s were obtained. The estimate regression parameters enabled obtaining predictors that are the most likely to predict the availability of school meals [30]. Statistical significance was estimated at $p < 0.05$.

Another binary logistic regression of availability of meals on to degree of implementation of GSFNIP was conducted to determine their relationship. *Nagelkerke* R^2, Chi-square (χ^2) test, *estimate regression parameters* i.e. *logits*, Wald (*t-test* for logits*), odds ratios (OR),* and *intercept*s were obtained. Statistical significance was estimated at $p < 0.05$.

6.3 Results

Head teachers' and schools' characteristics

The head teachers' characteristics are reported in Chapter 4, Table 4.1. Fifty-four percent of head teachers worked in government schools while 46% worked in private schools located in Mukono and Wakiso districts. Fifty-four percent of schools were urban schools while 46% were rural schools. School characteristics are presented in Table 6.1.

Distance from Kampala (km). Rural schools in this sample were on average 30 km away from Kampala, whereas urban schools were within a 19 km radius. Government-funded schools were on average 30 km from Kampala, while private schools were around 17 km from Kampala.

Availability of school meals. The proportion of schools that provided school meals was 71%. Urban areas had a higher proportion of schools providing meals than schools in rural areas (78 vs. 63, $\chi^2 = 5.9$, $p = 0.015$). A higher proportion of private schools provided school meals compared to government schools (78.0 vs. 65%, $\chi^2 = 4.7$, $p = 0.031$).

Teachers in schools. The average number of teachers in the sample of schools was 15, while the average number of qualified teachers was 13. Urban schools had a higher number compared to rural schools (17 vs. 12 teacher, t (215) = 2.3, $p = 0.042$). There was no difference (p

> 0.05) in the number of teachers in private and government schools. Urban schools had a higher number of qualified teachers than rural schools (14 vs. 10 teachers; t (208) = 3.4, p = 0.012).

Number of registered students. The average number of registered students in this sample of schools was 390 students. On average, government schools had more registered students than private schools (478 vs. 287; t (214) = -5.1, $p < 0.001$). There was no difference ($p > 0.05$) between the number of registered students in schools from rural and urban areas.

Years of school existence. On average, the schools in the sample have been in existence for at least 35 years. Schools located in rural areas were older than those in urban areas (43 vs. 28; t (206) = -3.7, $p < 0.001$). Also government schools had lived more years (56 vs. 10, t (206) = -17.2, $p < 0.001$) than private schools.

Correlation analysis

The results for the tests of the *primary null hypotheses* (i to iii) are provided in Table 6.4. Head teachers' nutrition knowledge score was directly associated with their awareness of the Guidelines (r = 0.2, p = 0.01), but not associated (r = -0.04, $p > 0.05$) with the degree of implementation of the Guidelines. Nonetheless, there was a direct association between head teachers' awareness of the Guidelines and the degree of their implementation (r = 0.32, $p < 0.01$).

Secondary results from correlation analysis are presented in Table 6.4. The details of descriptive statistics of the characteristics of the schools are reported (Appendix 4). Head teachers' nutrition knowledge was not associated ($p > 0.05$) with any of the other variables measured. Awareness scores were positively associated ($p < 0.05$) with number of school materials, the frequency of use of information, and the access to specific sources of nutrition information. It was also negatively associated with the years of existence of the school ($p < 0.05$). The degree of implementation of the Guidelines was positively correlated ($p < 0.05$) with the total number of teachers, the number of qualified teachers, a supportive school climate, higher number of school management practices, head teachers' professional development, level of school planning, level of school support for parents' involvement, the level of involvement of parents, the number of school materials, the frequency of use of sources of nutrition information, and the access to these sources.

Table 6.4. Correlation analysis of head teachers' and school characteristics with knowledge scores, awareness score and implementation level.

Head teachers' and school characteristic (Mean ± SE)	N	Knowledge	Awareness score	Implementation level (92.7 ± 24.3)
			r	
Distance of the school from Kampala (22.7 ± 1.18 km)	205	0.06	0.01	-0.09
Total number of teachers (15.0 ± 1.16)	205	0.14	0.1	0.20**
Number of Qualified teachers (13.0 ± 0.59)	205	0.11	0.07	0.31**
Number of Non-qualified teachers (2.0 ± 0.16)	205	-0.05	0.1	0.03
Number of non-teaching staff (8.0 ± 2.0)	203	0.08	0.1	0.06
Existence of school (35.2 ± 2.13 years)	197	0.06	-0.23**	-0.23**
Experience as teacher (18.7 ± 0.70 years)	202	0.06	-0.09	-0.21**
Experience as head teacher (9.7 ± 0.56 years)	201	0.03	0.05	-0.17*
School climate (31.8 ± 0.39)	204	-0.05	0.02	0.24**
School management practices (32.0 ± 0.43)	204	0.03	0.09	0.24**
Professional development (30.0 ± 0.40)	204	0.02	0.03	0.18**
School planning (17.1 ± 0.30)	203	-0.03	0.08	0.18*
School support for parents involvement (22.1 ± 0.36)	203	-0.02	-0.03	0.16*
Involvement of parents (13.1 ± 0.20)	203	0.07	0.13	0.29**
School materials (20.0 ± 0.32)	203	0.06	0.22**	0.34**
Frequency of use score (19.6 ± 1.17)	205	0.07	0.59***	0.33**
Access score (1.5 ± 0.15)	205	0.11	0.61***	0.28**
Number of registered students (394 ± 20.77)	203	0.07	0.09	0.12
Awareness score of school feeding & Nutrition Intervention guidelines (1.9 ± 0.16)	205	0.18**		0.32**
Total nutrition knowledge score (49.86 ± 0.77)	205		0.18**	-0.02

*$p < 0.05$, ** $p < 0.01$, ***$p < 0.001$

Multiple linear regression analyses

Awareness score as the dependent variable. The regression of awareness score on the variables shown in Table 6.5 for Model 1 (i.e., without head teachers' nutrition knowledge) accounted for a large proprotion (40.3%) of the variance explaining the awareness score (*Adjusted* $R^2 = 0.403$, F [11, 187] = 13.14, *MSE* = 3.0, $p < 0.001$). Head teachers' frequent use of sources of nutrition information ($\beta = 0.288$, $p = 0.003$) as well as higher access to such sources ($\beta = 0.329$, $p < 0.001$) were predictors of their awareness of the Guidelines. Addition of their *nutrition knowledge scores* to model one (i.e., Model 2) increased the proportion (42%) of variance explaining the awareness score (*Adjusted* $R^2 = 0.42$, F [12, 186] = 13.12, *MSE* = 2.9, $p < 0.001$). This represented a significant increase in R^2 by 0.022 (F [1, 186] = 7.7, $p = 0.006$). In Model 2, the results from the test of *primary hypothesis* (iv) showed that head teachers' *nutrition knowledge* was a predictor of their awareness of the Guidelines ($\beta = 0.158$, $p = 0.006$). Also, head teachers'

frequent use of sources of nutrition information (β = 0.297, p = 0.002), higher access to these sources (β = 0.304, p = 0.001) and higher education level (β = 0.121, p = 0.03) were predictors of awareness score.

Table 6.5. Regression of awareness scores on head teacher's and school characteristics, and nutrition knowledge score.

Model	Predicting variables	β	t	p-value	
1	(Constant)		0.072	0.943	Multiple R = 0.66
	Gender (Male =0, female =1)	0.002	0.042	0.967	$R^2_{Adj.}$ = 0.403
	Degree (No degree =0, degree = 1)	0.104	1.860	0.065	MSE= 3.0
	Ownership (Private= 0, Government =1)	-0.093	-1.450	0.149	F (11, 187) = 13.14
	Experience as teacher	-0.023	-0.316	0.753	$p < 0.001$
	Experience as head teacher	0.113	1.626	0.106	
	School climate	-0.101	-1.539	0.125	
	Involvement of parents	0.044	0.639	0.523	
	Frequency of use of sources of information	0.288	3.057	0.003	
	Access to the sources of information	0.329	3.546	0.000	
	School materials	0.098	1.431	0.154	
	Number of registered students	-0.069	-1.103	0.271	
2	(Constant)		-1.303	0.194	Multiple R = 0.68
	Gender (Male =0, female =1)	0.029	0.509	0.611	$R^2_{Adj.}$ = 0.423
	Degree (No degree =0, degree = 1)	0.121	2.185	0.030	MSE =2.9
	Ownership (Private= 0, Government =1)	-0.123	-1.926	0.056	F (12, 186) = 13.12
	Experience as teacher	-0.027	-0.365	0.716	$p < 0.001$
	Experience as head teacher	0.112	1.639	0.103	
	School climate	-0.082	-1.270	0.205	
	Involvement of parents	0.022	0.326	0.745	
	Frequency of use of sources of information	0.297	3.204	0.002	
	Access to the sources of information	0.304	3.325	0.001	
	School materials	0.092	1.370	0.172	
	Number of registered students	-0.074	-1.211	0.228	
	Total nutrition knowledge score	0.158	2.777	0.006	

Degree of implementation of the Guidelines as the dependent variable. The regression of the degree of implementation of the Guidelines on the variables shown in Table 6.6 for Model 1 (i.e., without head teachers' nutrition knowledge) accounted for a large proportion (34.5%) of the variance explaining the implementation levels (*Adjusted* R^2 = 0.35, F [8, 192] = 14.2, MSE = 336.5, $p < 0.001$). Schools owned by the government (β = -0.26, $p < 0.001$), the involvement of parents in school affairs (β = 0.14, p = 0.043), the number of qualified teachers present (β = 0.31, $p <$ 0.001), the number of school materials (β = 0.19, p = 0.007), and the awareness of head teachers' of the Guidelines (β = 0.163, p = 0.008) were predictors of the degree of implementation of the

Guidelines. Addition of head teachers' knowledge scores into model 1, did not increase the proportion of variance explained by the model (*Adjusted* R^2 = 0.34, F [9, 191] = 12.7, *MSE* = 336.9, $p < 0.001$). The same predicting variables in Model 1 remained significant in Model 2. Results on the tests for the *primary hypotheses* (v and vi) showed that head teachers' *general nutrition knowledge* was not a predictor of the degree of implementation of the Guidelines (β = -0.05, p = 0.378), whereas their awareness of the Guidelines was significant predictor of the degree of their implementation (β = 0.18, p = 0.005).

Table 6.6. Regression of implementation levels on head teachers' and school characteristics, and nutrition knowledge score.

Model	Predicting variables	β	t	p-value	
1	(Constant)		7.189	0.000	Multiple R = 0.61
	Gender (Male-0, Female-1)	-0.017	-0.298	0.766	$R^2_{Adj.}$ = 0.345
	Education (No degree-0, with a degree- 1)	0.045	0.778	0.438	*MSE* = 336.5
	Ownership (private-0, Government -1)	-0.257	-4.095	0.000	F (8, 192) = 14.2
	Experience as teacher (years)	-0.067	-1.087	0.278	$p < 0.001$
	Involvement of parents	0.139	2.038	0.043	
	Awareness score	0.163	2.692	0.008	
	Number of Qualified teachers	0.310	5.157	0.000	
	School materials score	0.192	2.750	0.007	
2	(Constant)		6.409	0.000	Multiple R = 0.61
	Gender (Male-0, Female-1)	-0.025	-0.429	0.669	$R^2_{Adj.}$ = 0.344
	Education (No degree-0, with a degree- 1)	0.039	0.663	0.508	*MSE* = 336.9
	Ownership (private-0, Government -1)	-0.246	-3.841	0.000	F (9, 191) = 12.7
	Experience as teacher (years)	-0.065	-1.055	0.293	$p < 0.001$
	Involvement of parents	0.143	2.099	0.037	
	Awareness score	0.175	2.816	0.005	
	Number of Qualified teachers	0.314	5.204	0.000	
	School materials score	0.190	2.716	0.007	
	Total Knowledge score	-0.054	-0.884	0.378	

Logistic regression

The logistic regression results are presented in Table 6.7. The logistic regression model was significant (χ^2 [10] =37.4, $p < 0.001$), Nagelkerke R^2= 0.25. The equation correctly classified 78.9% of the cases (benchmark classification accuracy = 74.6%). The test of the *primary hypotheses* (vii and viii) revealed that head teachers' awareness of the Guidelines (e^b = 1.22, p =

0.033) but not their *nutrition knowledge* (e^b = 1.00, $p > 0.05$) was a predictor of the availability of meals at schools. There was a 22% increased odds that head teachers who were aware of the guidelines were more likely to provide meals at schools. Secondary analyses showed that government schools and those schools with more children were 3-times (e^b = 4.03) and almost two times (e^b = 2.74) more likely to provide schools meals respectively.

The logistic regression model of availability of school meals on degree of implementation was significant (χ^2 [10] =72.3, $p < 0.001$), Nagelkerke R^2= 0.43. The classification accuracy was 83.4% (benchmark 75%). There were 9% increased odds of availability of school meals with higher degree of implementation of the guidelines (e^b = 1.09, $p < 0.001$).

Table 6.7. Prediction of availability of school meals with logistic regression.

Variable	*β*	SE	Wald (*t-test*)	OR (e^b)
Gender (Male =0, female =1)	-0.44	0.38	1.36	0.64
Education (No degree =0, degree = 1)	-0.60	0.40	2.24	0.55
Ownership (Private= 0, Government =1)	1.39	0.47	8.94**	4.03
Experience as teacher	-0.02	0.02	0.98	0.98
Experience as head teacher	0.05	0.03	2.40	1.05
School climate	0.03	0.04	0.59	1.03
Involvement of parents	0.08	0.07	1.35	1.09
Number of registered students	1.01	0.28	13.01***	2.74
Awarenesss score	0.20	0.09	4.56*	1.22
Total nutrition knowledge score	0.00	0.02	0.02	1.00
Constant	-3.13	1.59	3.86*	0.04

*$p < 0.05$, ** $p < 0.01$, ***$p < 0.001$, OR- Odds ratio

6.4 Discussion

Synthesis of results

The aim of this study was to explore nutrition knowledge of head teachers as one of the factors that influence adoption of the Uganda Guidelines on School Feeding and Nutrition Intervention Program (GSFNIP) and of the availability of meals at schools. The Diffusion of Innovation framework (Fig. 6.1) guided the analysis and interpretation of results, in which two adoption variables i.e. awareness and implementation of GSFNIP were included.

Correlation and multiple linear regression analyses helped to explore the relationship of head teachers' nutrition knowledge and the school environment characteristics with two variables that explain the adoption process namely head teachers' awareness of the Guidelines (i.e., awareness of the innovation) and the degree of implementation. From these analyses, head teachers

with higher general nutrition knowledge were more aware of the Guidelines, but not necessarily implementing specific activities as recommended. Results from the correlation analysis and logistic regression models support these findings as these demonstrated that head teachers' awareness of the GSFNIP, but not their general nutrition knowledge, was more likely to predict the presence of school meals. Results also showed that several school environment characteristics were associated with and predictive of the degree of implementation of the Guidelines and the provision of school meals. The degree of implementation of the guidelines increased chances of providing school meals. These relationships are shown in Figure 6.2.

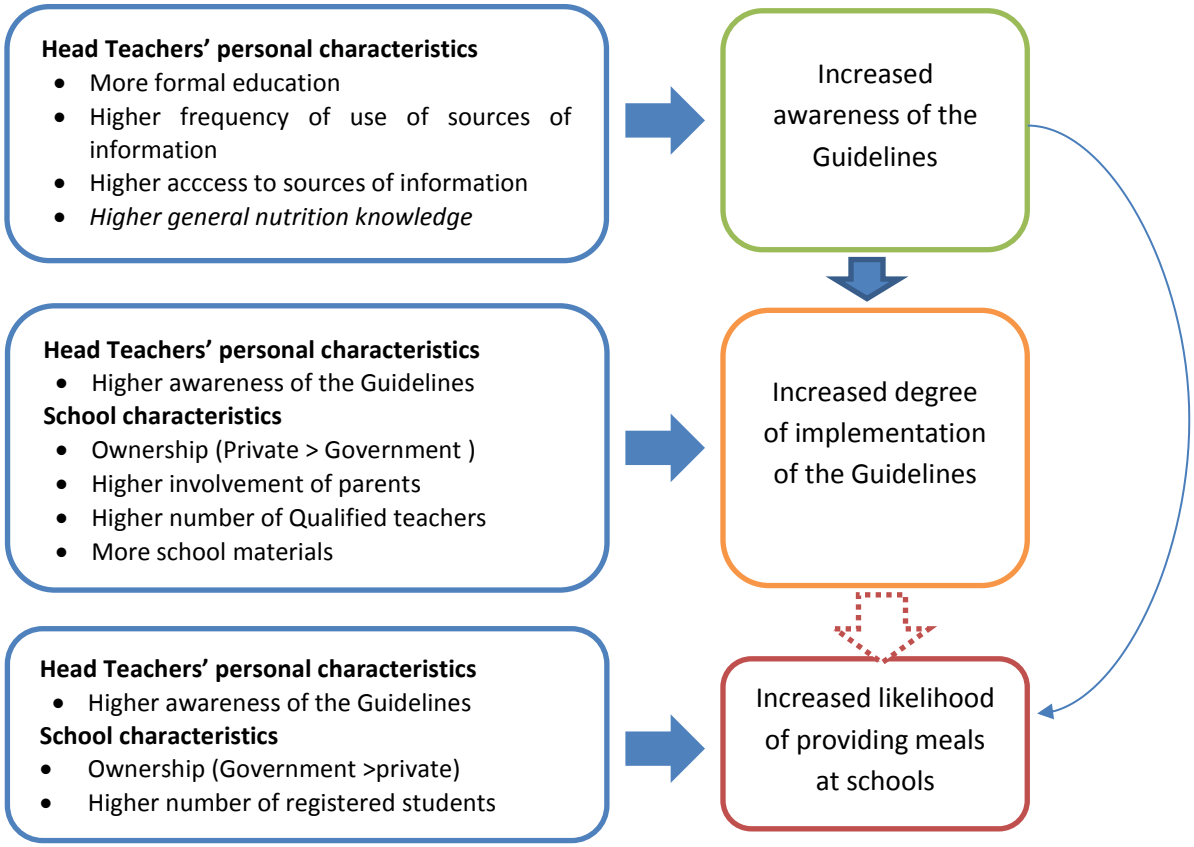

Fig. 6.2. Synthesis of results from multiple linear and logistic regresion analyses.

Knowledge influences adoption

In Uganda, government led or mandatory school lunch programs such as those present in other countries do not exist. Nonetheless, schools that decide to implement nutrition education or provide meals at schools must adhere, although with limited oversight, to the GSFNIP. The results from this dissertation work confirm the relationships between the different steps in the adoption

process namely awareness and implementation, in the context of Uganda policies. In this context, head teachers' who were more aware of the guidelines also reported the implementation of more recommended activities. An important finding is that head teachers' general nutrition knowledge predicted the awareness of these Guidelines. These results suggest that before adopting school nutrition interventions, it is critical to consider and enhance the basic nutrition knowledge of head teachers (i.e., adopters), which influence the adoption-decision process of several practices in the school setting.

According to a World Bank study [1], in Uganda nutrition education or training in basic nutrition concepts of educators and children, such as sources of nutrients and portion sizes, has not been a focus in many schools. Teachers' nutrition knowledge is associated with their level of engagement in providing courses with food and nutrition themes in schools [31, 32]. Moreover, improving nutrition knowledge among other behavioral attributes of educators ensures that they competently carry out prevention initiatives in schools [33]. Thus, improving the basic understanding of nutrition concepts (principle- knowledge) might reduce uncertainty at the different stages in the adoption process of the school-based nutrition interventions [3].

Applying the Diffusion of Innovation framework was useful in identifying personal characteristics of adopters as well as of the school environment that might facilitate awareness of and implementation of the recommended guidelines in schools. Awareness-knowledge of the ideal behaviors and practices has been related to nutrition related behaviors in recent studies [34- 36]. Personal characteristics of change agent such as their current knowledge as well as their ability to seek more knowledge can positively influence the likelihood to be aware of or adopt new ideas and innovations [4]. In this study, head teachers's general nutrition knowledge as well as their frequent use and access to documents such as the Uganda Food and Nutrition Policy [37], Uganda Nutrition Action Plan [38], the GSFNIP [2], the Internet, magazines and food labels were significant predictors of awareness of the GSFNIP. Previous studies have shown significant effects of different sources of information on awareness of specific programs [39, 40]. In addition, the level of academic education of head teachers might have increased their competence and ability to seek and understand different sources of information and hence improved their awareness of the GSFNIP. Existing knowledge within an organization could be used to identify, capture, share, reframe and recodify new knowledge of innovations [3,4]. The relationship between general

nutrition knowledge and awareness of specific guidelines has also been described previously [41, 42].

In their studies using the Diffusion of Innovation framework, Downs and colleagues (2012) explored the barriers associated with the adoption of the Alberta Nutrition Guidelines for Children and Youth in schools as reported by their principals (n = 357) [43]. Schools reported that parents' resistance to change and cost were two key barriers as well as lack of general knowledge of the guidelines, and physical location of the school. These findings replicate those observed by another study [6]. Deschenes et al., (2010) examined a prediction model likely to influence adoption of the Quebec Healthy Schools (QHS) approach using reports from a sample of school principals (n =96). These authors found that likelihood of adopting the QHS approach was influenced by the school location and knowledge level about QHS [6]. In their qualitative study, Rooney et al., (2017) using small sample of adults showed that although participants were aware of fruit and vegetable intake guidelines (i.e., '5-a-day campaign'), they were not sure on the meaning of the '5-a-day' message, including which foods were recommended as well as their estimated portion sizes [41]. In another study, Cho and colleagues evaluated general nutrition knowledge and its association with awareness of a food-nutrition labeling in a sample of girl's high school students in Kunsan, South Korea [42]. The authors showed that general nutrition knowledge in this group was relatively low (57% correct answers) and that, although important to make healthy choices, most students 'sometimes checked' the food label and about 40% felt using it. There was, however, a positive association between the degree of the nutrition label verification and the nutrition knowledge score of the subjects. As demonstrated in this study, existing nutrition knowledge of head teachers may be needed during the awareness stage of the adoption process; but this, however, does not guarantee that head teachers might implement practices as requested by the Government. Other predictors of implementation, as shown in Table 6.6 and 6.7 and argued by Deschenes' [6] and Downs' [43] studies, are the presence of more qualified teachers, more schools resources, and parent involvement.

School characteristics

In this study, the degree of implementation of the Guidelines was predicted by the status of school ownership, the involvement of parents, the number of qualified teachers, and school materials. A systematic review [4] reported that successful adoption and implementation of

innovations in organizations are positively influenced by budgets allocated to implement the innovation, competent implementers, degree of organizational members' involvement and teamwork, and multiple interactions within and outside the organization. In one study, school characteristics such as staff focus (specialization), increased available resources, school management, school goals, and program leadership were associated with the participation of teachers in school health promotion programs [44]. In another study, perceptions of teachers on school organization climate were related to consumption of fruits and vegetables in schools [45]. Therefore, factors associated with the school environment, the human capital resource, organizational structure, and location might influence adoption of government initiatives and policies [6].

Involvement of stakeholders such as parents and school leaders are factors that predict adoption levels of recommended school nutrition practices [4, 6]. Parent involvement has been shown to influence school-based nutrition interventions [46]. Involving parents in school nutrition interventions is associated with reduced risk of obesity among school children [47]. Furthermore, parental involvement was found to improve academic and emotional functioning among adolescents [48]. Involving parents can influence operating procedures of organizations by offering a wider breadth of knowledge and support to the functioning of an organization [49]. Therefore, sensitization on the existence of school nutrition guidelines among head teachers and parents is crucial to improving their awareness and implementation of GSFNIP.

An enabling school environment has been shown to improve adoption of new initiates [6, 49]. Available resources might include land for school gardens, library facilities, a higher number of human resource (teaching and non-teaching staff), and increase interschool networking. Available resources favor the adoption of school healthy guidelines [6]. Presence of available resources predicted the participation of teachers in school health promotion programs [44]. Another study showed that school climate and good school management improved the mental health of the teachers [50]. Lucarelli et al., (2014) used a qualitative approach to examine barriers and facilitators to healthy eating in schools. These authors showed that an enabling school environment such as one with the support from administrators (representing school management), teamwork among staff, and acknowledgement of student preferences (representing school climate), was a key characteristic to promote healthy eating in adolescents [51]. The performance of the different departments in school was related to access to resources [52].

In Uganda, government schools have a higher number of registered students, teachers, and years of existence indicating that they have higher access to resources and more established organizational structures [52]. In this study, schools owned by the Government were less likely to follow the Guidelines. Private schools are known to have more authoritative decision-making process while government schools have numerous levels of decision making on activities at schools [7, 53]. It is known that authoritative decision making hastens the rate of adoption [3, 4]. Poor monitoring of daily activities may also explain the low adoption levels in government schools compared to private schools. For example, absenteeism of teachers in government is twice that of teachers in private schools, which may demonstrate better monitoring of teachers' performance [7]. Improved monitoring and evaluation systems are known to increase the rate of adoption of innovation [3, 4]. Better (electronic) monitoring systems have improved implementation of health policies at schools and municipalities [54]. The longer distances from Kampala may also explain poor implementation of the Guidelines by government schools. Most government schools in this study were located further (30 km) away from Kampala compared to private schools (17 km). Kampala is both an administrative and business center. The longer the distance schools are from Kampala, the more logistical inadequacies (reduced access to resources) they might present. In the case of fortification, for example, facilities and resources (e.g., food, ingredients, and equipment) are mainly found in urban areas (Kampala), while in rural areas these resources might be less available [55]. Also, urban areas (areas around Kampala) tend to have more teachers [56]. Fielder et al., (2014) reported that rural schools have more logistical challenges to fill vacancies and retain qualified teachers compared to schools in urban areas [55]. In the World Bank study, it was revealed that 80% of teachers prefer to work in schools located near urban areas [56]. Some of the above factors may explain low levels of implementation of the Guidelines in government school compared to private schools.

In this study, results from logistic regression analysis showed that government schools were more likely to provide school meals, which may be attributed to favorable organizational characteristics and availability of various resources in the model [52]. Results in this study showed that were higher number of registered students (478 vs. 287 students) in government schools compared to private schools. This implies that increased number of students was related to ability of the school to mobilize and obtain financial and logistical resources required for meals i.e. government schools should have high number of registered students to provide school meals.

Although not reported in results, there were higher scores of head teachers' perceptions from government compared to private schools on professional development (31 vs. 29.4, t (214) = -2.04, p = 0.042), school planning (17.9 vs. 16.2, t (214) = -2.88, p = 0.004), and school support for parent involvement (22.7 vs. 21.4, t (214) = -2.00, p = 0.047). These organization characteristics may further explain increased ability to mobilize resources needed for school meals.

Limitations of the study

The results of this study should be treated with caution. The sample was mainly of head teachers from schools in Mukono and Wakiso districts, which are largely urban or peri-urban with relatively higher access to different sources of information such as from the Internet on their phones. Access to information in the study areas (Mukono and Wakiso) was largely similar. Although not reported, the access score for sources of information was not different (t (203) = 0.92, p = 0.359) between rural and urban areas. Use of different sources of information such as the Internet in Chapter 4 studies was related to increased general nutrition knowledge. The obtained models, can be applied to other populations in Uganda. Also, personal characteristics of head teachers' and school characteristics did not include individual interactions represented by attributes in behavioral frameworks [57]. Adoption of the practices may not imply influence on the feeding behaviors and practices among the school children. The Diffusion of Innovation could be combined with other frameworks such as the Social Cognitive Theory to explore the relationship of adoption the Guidelines and feeding practices among school children.

The results were obtained from a cross-sectional survey design, and thus, do no establish any causal relationships. Longitudinal and experimental designs can be employed in the future to study the effect of nutrition knowledge and other school characteristics on the adoption process of school nutrition guidelines and policies.

6.5 Conclusion

Results of two multiple linear regressions suggest head teachers' nutrition knowledge influenced adoption of the Guidelines through improving awareness on GSFNIP, which requires further investigation by path analysis using Structural Equation Modelling [11]. Also, mediating and modulating effects of nutrition knowledge could be studied to further understand the relationships.

The observed relationship of general nutrition knowledge of head teachers and awareness of the GSFNIP, which in turn predicts the level of implementation of the GSFNIP suggest that prior basic nutrition knowledge of head teachers is an important factor to consider before introducing different nutrition interventions in schools. Improving general nutrition knowledge of head teachers can be considered at teacher training institutions or during their professional development.

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CHAPTER 7: SUMMARY AND FUTURE DIRECTIONS

This dissertation presents several studies that advance the ability to evaluate general nutrition knowledge of adults in Uganda. The general nutrition knowledge questionnaire (GNKQ) was administered to head teachers and, after several validation steps, the results showed acceptable psychometric properties such as construct validity (i.e., content, face, concurrent and predictive validity), and reliability of items (Table 7.1). In addition, this questionnaire produced reliable nutrition knowledge data on a group of community extension workers, further establishing its external validity.

Several pieces of evidence have shown that knowledge of school head teachers is an important determinant in the level of implementation of nutrition interventions. Head teachers are key change agents in schools, and thus, understanding potential barriers such as low nutrition knowledge might shed some light to explain the great degree of variability in the innovation-decision process, which instead modulates the level of implementation and effectiveness of nutrition interventions. Reliable nutrition knowledge data has not been in the mainstream literature in Uganda. This was partly because of the lack of valid questionnaires to evaluate it and the limited efforts to evaluate it among school head teachers. Obtaining and validating a nutrition knowledge questionnaire was key to "kick start" its evaluation in Uganda.

The questionnaire obtained in this study can be used to evaluate nutrition knowledge of adult groups in Uganda. Although two of the sections i.e. "*Expert recommendation*s" and "*Selecting food*s" in this dissertation consistently yielded results with questionable reliability. The domains with the items in the GNKQ are important to evaluate nutrition knowledge of adults in Uganda based on acceptable results of content and face validity. Review of the items in the above domains and conducting more surveys using the GNKQ is necessary. However, emphasis should be given on reporting the different psychometric measures on reliability. Also, time after time the questionnaire should be reviewed to fit different populations and situations in Uganda. A shorter version of this questionnaire might be constructed from this one to reduce the time of administering the questionnaire, especially if the interest is on the overall nutrition knowledge of participants.

The first field surveys showed that draft GNKQ had acceptable content and face validity and construct validity to evaluate nutrition knowledge in the head teacher population. This is the first-time quantitative measures of content and face validity are used in validating a nutrition

knowledge questionnaire. Content validity index (proportion agreement) and Gwet's AC1 were used. Gwet's AC1 is a recent measure of agreement reliability that has limited use in nutrition literature. Other field and community nutrition studies using questionnaires can employ the techniques used in this study.

It is also the first time that basic nutrition knowledge of head teachers in Uganda has been recorded. The implication of scores to represent different nutrition situations needs further study. Performance rating scales, i.e., knowledge thresholds, need to be generated for the head nutrition knowledge scores to predict different levels of the adoption process. Establishing knowledge benchmarks for performance could help policy makers to plan on nutrition education target goals for implementers and thus prioritize those schools that require nutrition education.

Data of nutrition knowledge of head teachers can be used to evaluate the impact of ongoing and future school nutrition education interventions focusing head teachers. Studies on head teachers' nutrition knowledge to influence their decisions on different key school nutrition interventions are possible with the availability of this questionnaire. Using online platforms with increasing use of the internet by the head teachers can be explored in the future to ease the logistic burden, and overall survey cost such as for enumeration and transportation. Also, using such platforms could reduce data management workload and hence making evaluations faster and regular.

The instrument developed, mainly evaluates declarative nutrition knowledge. Future studies need to explore developing instruments evaluating knowledge on how to achieve adequate nutrition among adults i.e. procedural knowledge.

Finally, the experience obtained in this study can be used to develop questionnaires to evaluate general nutrition knowledge in other populations with different age groups in Uganda. The experience can be replicated in other studies that include different behavioral determinants.

Table 7.1. Summary of findings on validation from Chapter 1 to 6.

Studies in	Psychometric measured used in validation process					
	Content validity	**Face validity**	**Concurrent validity**	**Predictive validity**	**Internal consistency**	**Test-retest reliability**
Chapter I	Definition of nutrition knowledge					
Chapter II	Evaluation of Nutrition knowledge among change agents was relevant in Uganda					
Chapter III	Domains and Items were relevant in Uganda to evaluate nutrition knowledge	Target population understood sections and items in draft GNKQ	Nutrition knowledge of nutrition students and engineering student was different		Four of five domains produce consistent data. Items in "Expert recommendations" did not produce reliable results	Four of five sections produced reliable data. Items in "Expert recommendations" did not produce reliable results
Chapter IV					Items in all five domains produced consistent data	Three of five sections produced reliable data. Items in "Expert recommendations" produce unacceptable to acceptable results. Items in "Selecting food" produce unacceptable results
Chapter V				Nutrition knowledge influenced adoption process of school nutrition guidelines		
Chapter VI					Four of five domains produced consistent data. Items in "Selecting food" did not produce reliable results	Four of five sections produced reliable data. Items in "Selecting food" did not produce reliable results

APPENDIX A: FIRST DRAFT OF GENERAL NUTRITION KNOWLEDGE QUESTIONNAIRE FOR ADULTS

Nutrition survey
This is a survey, not a test. Your answers will help identify which dietary advice adult people find confusing.
1. It is important that you complete it by yourself.
2. Your answers will remain anonymous.
3. If you do not know the answer, mark "not sure" rather than guessing.

A. The first few items are about what advice you think experts are giving in the community

1. Do you think health experts recommend that people should be eating more, the same amount, or less of these foods? (tick one box per food)

	More	Same	Less	Not sure
Vegetables	☐	☐	☐	☐
Sugary foods	☐	☐	☐	☐
Meat	☐	☐	☐	☐
Starchy foods	☐	☐	☐	☐
Fatty foods	☐	☐	☐	☐
High fibre or roughage	☐	☐	☐	☐
Fruits	☐	☐	☐	☐
Salty foods	☐	☐	☐	☐

2. How many servings of fruit and vegetables a day do you think experts are advising people to eat? (*One serving could be, for example, an apple, an orange or a handful of dodo, carrots or bugga*)

Servings of Fruits ☐ Not sure

Servings of vegetables ☐ Not sure

3. Which fats do experts say that are most important to cut down on? (tick one box per food)

	Yes	No	Not sure
Cod fish liver oil	☐	☐	☐
Fish	☐	☐	☐
butter	☐	☐	☐
meat	☐	☐	☐
Ground nuts	☐	☐	☐

4. What version of dairy foods do experts say people should eat? (tick one)

a) Mixture of full and lower fat ☐ b) lower fat ☐ c) Full fat ☐

d) Should not take dairy food ☐ e) Not sure ☐

B. Experts classify foods into groups. We are interested to see whether people are aware of what foods are in these groups

1. Do you think these are high or low in added sugar? (tick one box per food)

	High	Low	Not sure
Bananas	☐	☐	☐
Unflavoured yoghurt	☐	☐	☐
Ice- cream	☐	☐	☐
Tomato sauce (tinned)	☐	☐	☐
Fruit juice (processed)	☐	☐	☐
Natural tinned juice	☐	☐	☐

2. Do you think these are high or low in fat? (tick one box per food)

	High	Low	Not sure
Chapatti	☐	☐	☐
Low fat blue band	☐	☐	☐
Beans	☐	☐	☐
Sausages	☐	☐	☐
Honey	☐	☐	☐
Egg beaten, fried (omelette)	☐	☐	☐
Ground nuts	☐	☐	☐
Bread	☐	☐	☐
Cheese	☐	☐	☐
Butter	☐	☐	☐

3. Do you think experts put these in the starchy foods group? (tick one box per food)

	Yes	No	Not sure
Milk	☐	☐	☐
Rice	☐	☐	☐
Butter	☐	☐	☐
Ground nuts	☐	☐	☐
Bread	☐	☐	☐
Maize porridge	☐	☐	☐

4. Do you think these are high or low in salt? (tick one box per food)

	High	Low	Not sure
Sausages	☐	☐	☐
Chapatti	☐	☐	☐
Smoked fish	☐	☐	☐
Beef	☐	☐	☐
Vegetables	☐	☐	☐
cheese	☐	☐	☐

5. Do you think these are high or low in protein? (tick one box per food)

	High	Low	Not sure
Chicken	☐	☐	☐
mangoes	☐	☐	☐
Beans	☐	☐	☐
Beef	☐	☐	☐
Amaranth (dodo)	☐	☐	☐
Stiff porridge (posho)	☐	☐	☐
Yogurt	☐	☐	☐

6. Do you think these are high or low in fibre/roughage?(tick one box per food)

	High	Low	Not sure
chapatti	☐	☐	☐
bananas	☐	☐	☐
eggs	☐	☐	☐
Beef	☐	☐	☐
cabbage	☐	☐	☐
Ground nuts	☐	☐	☐
Fish	☐	☐	☐
Irish potatoes with skins	☐	☐	☐
Chicken	☐	☐	☐
beans	☐	☐	☐

7. Do you think these fatty foods are high or low in saturated fat? (tick one box per food)

	High	Low	Not sure
Fish	☐	☐	☐
Whole milk	☐	☐	☐
Olive oil	☐	☐	☐
beef	☐	☐	☐
Sunflower oil	☐	☐	☐
chocolate	☐	☐	☐

8. Some foods contain a lot of fat but no cholesterol. (tick one)

   a) Agree ……..☐
   b) Disagree ……☐
   c) Not sure ……..…..☐

9. Do you think experts call these a healthy alternative to beef? (tick one box per food)

	Yes	No	Not sure
Liver	☐	☐	☐
Sausage	☐	☐	☐
Beans	☐	☐	☐
Ground nuts	☐	☐	☐
Yogurt	☐	☐	☐
Egg beaten, fried (omelette)	☐	☐	☐

10. A glass of unsweetened fruit juice counts as a helping of fruit. (tick one)

    a) Agree ☐ b) Disagree ☐ c) Not sure ☐

11. Saturated fats are mainly found in:(tick one)

    a) Vegetable oils ☐ b) Dairy products ☐ c) both "a" and "b" ☐ d) Not sure ☐

12. Brown sugar is a healthy alternative to white sugar. (tick one)

    a) Agree ☐ b) Disagree ☐ c) Not sure ☐

13. There is more protein in a glass of whole milk than in a glass of skimmed milk. (tick one)

    a) Agree ☐ b) Disagree ☐ c) Not sure ☐

14. Vegetable oil contains less fat than kimbo. (tick one)

    a) Agree ☐ b) Disagree ☐ c) Not sure ☐

15. Which of these breads contain the most vitamins and minerals? (tick one)

    a) White ☐ b) Brown ☐ c) Whole grain ☐ d) Not sure ☐

16. Which do you think is high energy: butter or blue band? (tick one)

    a) Butter ☐ b) blue band ☐ c) both the same ☐ d) Not sure ☐

17. A type of oil which contains mostly monounsaturated fat is: (tick one)

    a) Coconut oil ☐ b) sunflower oil ☐ c) Olive oil ☐ d) palm oil ☐ e) Not sure ☐

18. There is more calcium in a glass of whole milk than a glass of skimmed milk (milk with fat removed).

    a) Agree ☐ b) Disagree ☐ c) Not sure ☐

19. Which one of the following provides the most energy for the same weight? (tick one)

    a) Sugar ☐ b) starchy foods ☐ c) fibre/ roughage ☐ d) Fat ☐ e) not sure ☐

20. Harder fats contain more: (tick one)

    a) Monounsaturates ☐ b) polyunsaturates ☐ c) saturates ☐ d) Not sure ☐

21. Polyunsaturated fats are mainly found in:(tick one)

    a) Vegetable oils ☐ b) Dairy products ☐ c) both "a" and "b" ☐ d) Not sure ☐

C. The next few items are about choosing foods

Please answer what is being asked and not whether you like or dislike the food!
For example, suppose you were asked . . . . . .
"If a person wanted to cut down on fat, which meat would be best to eat?"
a) Chicken
b) Beef
c) Beef sausage
d) Pork
If you didn't like chicken, but knew it was the right answer, you would still tick chicken.

1. Which would be the best choice for a low fat, high fibre/ roughage snack? (tick one)

   a) Diet strawberry yogurt ☐ b) Dried mangoes ☐ c) Simsim bar ☐ d) Potato crisps ☐

2. Which would be the best choice for a low fat, high fibre light meal? (tick one)

   a) Grilled chicken ☐ b) Cheese on bread ☐ c) beans and bread ☐ d) Egg omelette ☐

3. Which kind of sandwich do you think is healthier? (tick one)

   a) Two thick slices of bread with a thin slice of cheese filling……. ☐

   b) Two thin slices of bread with a thick slice cheese filling …….…….. ☐

4. Many people eat thick porridge (posho) with meat sauce. Which do you think is healthier? (tick one)

   a) A large amount of thick porridge with a little meat sauce on top …….☐

   b) A small amount of thick porridge with a lot of meat sauce on top…….. ☐

5. If a person wanted to reduce the amount of fat in their diet, which would be the best choice? (tick one)

   a) Fish, grilled ☐ b) Sausages, grilled ☐ c) Beef steak, grilled ☐ d) Pork chop, grilled ☐

6. If a person wanted to reduce the amount of fat in their diet, but didn't want to give up chips, which one would be the best choice? (tick one)

   a) Thick cut chips☐ b) thin cut chips ☐

7. If a person felt like something sweet, but was trying to cut down on sugar, which would be the best choice? (tick one)

   a) Honey on bread……..☐
   b) Flavoured yogurt …… …….. ☐
   c) Plain Digestive biscuit……....☐
   d) Banana with plain yoghurt ……☐

8. Which of these would be the healthiest pudding? (tick one)

   a) Baked apple ……..……..…….☐
   b) Strawberry yoghurt …….……..☐
   c) Whole meal biscuits ……..☐
   d) Carrot cake with cream topping ……..……..☐

9. Which of these snacks would be the best choice as a lower fat option? (tick one)

   a) Cassava fresh, fried ……..……..……..☐
   b) Chapati fried……...…☐
   c) Samosa peas filling, fried……..……☐
   d) Ground nuts fried ……..……☐

10. If a person wanted to reduce the amount of salt in their diet, which would be the best choice? (tick one)

    a) Roasted pork with pineapple……..…….……..☐
    b) Mushroom ……..……..☐
    c) Vegetables with soy sauce……..……..☐
    d) Sausages with cabbages …….……..☐

D. This section is about health problems or diseases

1. Are you aware of any major health problems or diseases that are related to a low intake of fruit and vegetables? (tick one)

   a) Yes ☐ b) no ☐ c) not sure ☐

   If yes, what diseases or health problems do you think are related to a low intake of fruit and vegetables?

2. Are you aware of any major health problems or diseases that are related to a low intake of fibre?

   a) Yes ☐ b) no ☐ c) not sure ☐

   If yes, what diseases or health problems do you think are related to low intake of fiber?

3. Are you aware of any major health problems or diseases that are related to how much sugar people eat?

   a) Yes ☐ b) no ☐ c) not sure ☐

   If yes, what diseases or health problems do you think are related to sugar?

4. Are you aware of any major health problems or diseases that are related to how much salt or sodium people eat?

   a) Yes ☐ b) no ☐ c) not sure ☐

   If yes, what diseases or health problems do you think are related to salt?

5. Are you aware of any major health problems or diseases that are related to the amount of fat people eat?

   a) Yes ☐ b) no ☐ c) not sure ☐

   If yes, what diseases or health problems do you think are related to fat?

6. Do you think these help to reduce the chances of getting certain kinds of cancer? (answer each one)

	Yes	No	Not sure
Eating more fibre or roughage	☐	☐	☐
Eating less sugar	☐	☐	☐
Eating less fat	☐	☐	☐
Eating less salt	☐	☐	☐
Eating more fruits and vegetables	☐	☐	☐
Eating less preservatives/ additives	☐	☐	☐

7. Do you think these help prevent heart disease? (answer each one)

	Yes	No	Not sure
Eating more fibre or roughage	☐	☐	☐
Eating less fat	☐	☐	☐
Eating less salt	☐	☐	☐
Eating more fruits and vegetables	☐	☐	☐
Eating less preservatives/ additives	☐	☐	☐

8. Which one of these is more likely to raise people's blood cholesterol level? (tick one)

a) Vegetables …….. ☐

b) Fruits ……..…….. ☐

c) Animal fats……..…….. ☐

d) Plant oils……..……..…….. ☐

e) Legumes ……..…..……..☐

f) Not sure……..☐

9. Have you heard of antioxidant vitamins?

a) Yes ☐ b) No ☐

10. If YES to question 9, do you think these are antioxidant vitamins? (Answer each one)

	Yes	No	Not sure
Vitamin A	☐	☐	☐
B complex vitamins	☐	☐	☐
Vitamin C	☐	☐	☐
Vitamin E	☐	☐	☐
Vitamin K	☐	☐	☐

E. Experts recommend consuming foods with more vitamins and minerals. Food companies add them through a process called fortification (i.e. fortified foods).

1. Have you heard about, seen, or used any fortified food on the market?

   a) Yes ☐ b) No ☐

2. Which of the following foods have nutrients added (fortified)? (tick one box per food)

	Yes	No	Not sure
Pancakes	☐	☐	☐
Vegetable oil	☐	☐	☐
Sugar	☐	☐	☐
Maize flour	☐	☐	☐
Wheat flour (engano)	☐	☐	☐
Plantain (matooke)	☐	☐	☐
Salt	☐	☐	☐
Fresh beans	☐	☐	☐
Fish	☐	☐	☐

3. Have you seen any of these logos on the label of packages of foods with added nutrients (fortified). (tick one box per logo)

	Yes	No	Not sure
	☐	☐	☐
	☐	☐	☐
	☐	☐	☐
	☐	☐	☐

F. Sources of Information: In this section we are seeking for the sources of information you use

1. Where do you get your information about nutrition?

Source	Yes	No
Schools	☐	☐
Peers/friends	☐	☐
Health personnel	☐	☐
Radio/TV/ magazines/books	☐	☐
Internet	☐	☐
Other (specify)……	☐	☐
……..……	☐	☐

2. From the choices you have selected above, how would you rate them as sources of information? (circle one choice)

1= very unreliable

2= unreliable

3= reliable

4= very reliable

Source	Very unreliable	unreliable	reliable	Very reliable
Schools	1	2	3	4
Peers/friends	1	2	3	4
Health personnel	1	2	3	4
Radio/TV/ magazines/books	1	2	3	4
Internet	1	2	3	4
Other (specify)……..	1	2	3	4
……	1	2	3	4

G. Finally, we would like to ask you a few questions about yourself

1. Are you male or female?
   a) Male …….. ☐
   b) Female ……..…….. ☐
2. How old are you?
   a) Less than 18…….. ☐
   b) 18 -24 …….. ☐
   c) 25 -34 …….. ☐
   d) 35 - 44 …….. ☐
   e) 45 -54 …….. ☐
   f) 55 - 64 …….. ☐
   g) 65 - 74 …….. ☐
   h) More than 74 ……..…….…….. ☐
3. Do you have any children?
   a) No …….. ☐
   b) 1 ……..…….. ☐
   c) 2 ……..…….. ☐
   d) 3 ……..…….. ☐
   e) 4 ……..…….. ☐
   f) More than 4 ……..…….. ☐
4. Do you have any children under 18 years, living with you?
   a) Yes ……..…….. ☐
   b) No ……..……..…….. ☐
5. What is the highest level of education you have completed?
   (a) Primary school ……...…….. ☐
   (b) Secondary school ……..…….. ☐
   (c) O level ……..…….. ☐
   (d) A level ……..…….. ☐
   (e) Technical or tertiary certificate ……..……..…….. ☐
   (f) Diploma …….. ☐
   (g) Degree ……..…….. ☐
   (h) Post-graduate degree ……..……...….. ☐

6. Do you have any nutrition related qualification or are you currently a nutrition student?
   a) Yes …… ☐

      Please specify

   b) No …… ☐
7. If you have a partner, does he/she have any nutrition related qualification or student?
   a) Yes …… ☐

      Please specify

   b) No …… ☐
8. If you have a partner, what is his/her job? If he/she is not working now, what is his/her usual job? (please be specific):

9. Are you on a special diet?
   a) Yes …… ☐

   Please specify:

   b) No…… ☐

THE END

Thank you very much for your time. If there are any comments you would like to make about this questionnaire, please do so below, they would be very welcome.

APPENDIX B: NUTRITION KNOWLEDGE QUESTIONNAIRE FOR ADULTS WITH RIGHT ANSWERS

Nutrition survey
This is a survey, NOT a test. Your answers will help identify which dietary advice to adult people that is not clear.
1. It is important that you complete the questionnaire by yourself.
2. Your answers will remain anonymous.
3. If you do not know the answer, mark "not sure" rather than guessing.

A. The first few items are about what advice you think experts are giving in the community.

1. Do you think health experts recommend that people should be: i) eating more of the under listed food or ii) less of the under listed food? (*tick one box per food*)

	More	Less	Not sure
Vegetables	☒	☐	☐
Sugary foods	☐	☒	☐
Meat	☐	☒	☐
Starchy foods	☒	☐	☐
Fatty foods	☐	☒	☐
High fibre or roughage	☒	☐	☐
Fruits	☒	☐	☐
Salty foods	☐	☒	☐

2. How many servings of fruits and vegetables a day do you think health/ nutrition experts are advising people to eat? (*One serving could be, for example, an apple, an orange or a handful of dodo, carrots or bugga*)- *Write the ONLY the minimum number of servings*.

2 Servings of fruits ☐ Not sure

3 Servings of vegetables ☐ Not sure

3. Which under listed sources of fats do health/ nutrition experts say should be reduced in the diet? (*tick one box per food*)

	Yes	No	Not sure
Pork	☒	☐	☐
Fish	☐	☒	☐
Margarine/Butter	☒	☐	☐
Beef	☒	☐	☐
Ground nuts	☐	☒	☐

4. What version of dairy food products do health/ nutrition experts say people should eat to reduce or maintain body weight? (*tick one*)

Full cream milk ……..…….☐

Yoghurt ……..…..…...☒

Should not take any dairy foods…..☐

Not sure……..…..☐

B. Experts classify foods into groups. We are interested to know whether people are aware of what foods are in these groups.

1. Do you think the under listed foods have added sugar? (*tick one box per food*)

	Yes	No	Not sure
Bananas	☐	☒	☐
Stiff porridge (posho)	☐	☒	☐
Soda	☒	☐	☐
Plantain (matooke)	☐	☒	☐
Quencher juice	☒	☐	☐
Ripe Mangoes	☐	☒	☐

2. Do you think the under listed foods are high or low in fat? (*tick one box per food*)

	High	Low	Not sure
Chapatti	☒	☐	☐
Margarine e.g. blueband	☒	☐	☐
Beans	☐	☒	☐
Sausages	☒	☐	☐
Honey	☐	☒	☐
Eggs	☐	☒	☐
Ground nuts	☒	☐	☐
Bread	☐	☒	☐
Simsim	☒	☐	☐
Ghee	☒	☐	☐

3. Which of the under listed foods do you think health/nutrition experts classify under starchy foods group? (*tick one box per food*)

	Yes	No	Not sure
Milk	☐	☒	☐
Rice	☒	☐	☐
Beans	☐	☒	☐
Fish	☐	☒	☐
sweet potatoes	☒	☐	☐
Maize porridge	☒	☐	☐

4. Do you think the under listed foods has high or low salt? (*tick one box per food*)

	High	Low	Not sure
Sausages	☒	☐	☐
Chapatti	☐	☒	☐
Smoked fish	☒	☐	☐
Beef	☐	☒	☐
Amaranths (dodo)	☐	☒	☐
Groundnut paste	☐	☒	☐

5. Do you think the under listed foods are high or low in protein? (*tick one box per food*)

	High	Low	Not sure
Chicken	☒	☐	☐
Mangoes	☐	☒	☐
Beans	☒	☐	☐
Beef	☒	☐	☐
Stiff porridge (posho)	☐	☒	☐
Yogurt	☒	☐	☐

6. Do you think the under listed foods are high or low in fibre/roughage?(*tick one box per food*)

	High	Low	Not sure
Stiff porridge (posho)	☐	☒	☐
Bananas	☐	☒	☐
Eggs	☐	☒	☐
Beef	☐	☒	☐
Cabbage	☒	☐	☐
Ground nuts	☒	☐	☐
Fish	☐	☒	☐
Irish potatoes with skins	☒	☐	☐
Chicken	☐	☒	☐
Beans	☒	☐	☐

7. Do you think health/ nutrition experts call the under listed foods healthy alternatives to beef? (*tick one box per food*)

	Yes	No	Not sure
Sweet potatoes	☐	☒	☐
Sausage	☐	☒	☐
Beans	☒	☐	☐
Ground nuts	☒	☐	☐
Yogurt	☒	☐	☐
Bread	☐	☒	☐

8. A glass of unsweetened fruit juice is a good alternative to the real fruit. (*tick one*)

Agree	☒
Disagree	☐
Not sure	☐

9. Brown sugar is a healthy alternative to white sugar. (*tick one*)

Agree	☒
Disagree	☐
Not sure	☐

10. A glass of whole milk has more protein than a glass of yoghurt. (*tick one*)

Agree	☐
Disagree	☒
Not sure	☐

11. A cup of liquid vegetable oil (e.g mukwano) has less fat content than a cup of solid oil (e.g. kimbo). (*tick one*)

Agree	☐
Disagree	☒
Not sure	☐

12. Which of these bread types contain the most vitamins and minerals? (*tick one)*

White	☐
Brown	☐
Wholegrain	☒
Not sure	☐

13. Which of the two foods do you think contain high energy: butter or regular margarine (e.g. blue band)? (*tick one*)

Butter	☐
Margarine (e.g. Blue band)	☐
Both the same	☒
Not sure	☐

14. There is more calcium in a glass of whole milk than a glass of yoghurt. (*tick one*)

Agree	☐
Disagree	☒
Not sure	☐

15. Which one of the following food groups provides the highest energy for the same weight? (*tick one*)

A half kilogram of sugar ……	☐
A half kilogram of starchy foods……	☐
A half kilogram of Fibre/ roughage……	☐
A half kilogram of Fat……	☒
Not sure……	☐

16. Table sugar has a lot of vitamins and minerals. (*tick one*)

Agree	☐
Disagree	☒
Not sure	☐

17. Do you think that the under listed foods are rich in vitamin A? (*Tick one box per food*)

	Yes	No	Not sure
Carrots	☒	☐	☐
Spinach	☒	☐	☐
Yellow fleshed sweet potatoes	☒	☐	☐
Maize	☐	☒	☐
Matooke	☐	☒	☐
Rice	☐	☒	☐
Wheat	☐	☒	☐
Coffee	☐	☒	☐

C. The next few items are about choosing foods.

Please answer what is being asked and not whether you like or dislike the food!
For example, suppose you were asked . . . . . .
If a person wanted to cut down on fat, which meat would be best to eat?'
a) Chicken
b) Beef
c) Beef sausage
d) Pork
If you do not like chicken, but know it is the right answer, you would still tick chicken.

1. Which would be the best choice for a low fat, high fibre/ roughage snack? (*tick one*)
   Roasted groundnuts….☐
   Ripe mango……..….☒
   Sim sim……☐
   Not sure……☐
2. Which would be the best choice for a low fat, high fibre meal? (*tick one*)
   Beef and plantain (matooke)……☐
   Groundnuts and plantain (matooke)…….☐
   Beans and Plantain (matooke)…….……☒
   Fish and plantain (matooke)…….☐
   Not sure……☐
3. Many people eat thick porridge (posho) with beans. Which do you think is healthier? (*tick one*)
   Stiff porridge (posho) with fried beans and dodo……..☒
   Stiff porridge (posho) with fried beans and potato chips…….....☐
   Not sure……...☐
4. If a person wanted to reduce the amount of fat in their diet, which would be the best choice? (*tick one*)
   Fish, grilled……..….☒
   Sausages, grilled……..….☐
   Beef steak, grilled…….☐
   Pork chop, grilled ……☐
   Not sure ……..…..……☐
5. If a person wanted to reduce the amount of fat in their diet, but didn't want to give up chips, which one would be the best choice? (*tick one*)
   Thick cut chips ☒
   Thin cut chips ☐
   Not sure ☐

6. If someone felt like eating something sweet, and at the same time trying to cut down on sugar, which would be the best choice? (*tick one*)
   - Honey on bread…….. ☐
   - Flavoured yoghurt …… ☐
   - Biscuits……... ☐
   - Banana with plain yoghurt …… ☒
   - Not sure ……. ☐

7. Which of these snacks would be the best choice as a lower fat option? (*tick one*)
   - Cassava fresh, fried ……..…….. ☒
   - Chapatti fried…….…….. ☐
   - Samosa beans filling, fried…….. ☐
   - Not sure …….…….. ☐

8. If a person wanted to reduce the amount of salt in their diet, which would be the best choice? (*tick one*)
   - Roasted pork and pineapple……..…….. ☐
   - Mushroom and ground nuts……. ☒
   - Vegetables with soy sauce…… ….. ☐
   - Sausages with cabbages …….. ☐
   - Not sure …… ……. ☐

9. Which consistence of porridge do you think should be given to the children? (*tick one*)
   - Thick porridge……. ☒
   - Watery porridge…….. ☐
   - Not sure……... ☐

10. Why do think we should give the type of porridge in question 9? (*tick one*)
    - It is less thick and nutrients can easily be absorbed…… ☐
    - There are more ingredients and nutrients can be easily absorbed…….. ☒
    - I am not sure……... ☐

D. This section is about health problems or diseases associated with nutrition.

1. Are you aware of any major health problems or diseases that are related to a low intake of fruit and vegetables? (*tick one*)

   Yes ☒
   No ☐
   Not sure ☐

   If yes, what diseases or health problems do you think are related to a low intake of fruit and vegetables? (*Name at least one*)

   Heart disease, cancer, bower disorders, anaemia, low immunity

2. Are you aware of any major health problems or diseases that are related to a low intake of fibre or roughage?

   Yes ☒
   No ☐
   Not sure ☐

   If yes, what diseases or health problems do you think are related to low intake of fiber or roughage? (*Name at least one*)

   Bowel disorders (constipation, IBD etc)

3. Are you aware of any major health problems or diseases that are related to how much sugar people eat?

   Yes ☒
   No ☐
   Not sure ☐

   If yes, what diseases or health problems do you think are related to eating sugary foods like sweets? (*Name at least one*)

   teeth decay, diabetes, obesity

4. Are you aware of any major health problems or diseases that are related to how much salt or sodium people eat?

   Yes ☒
   No ☐
   Not sure ☐

   If yes, what diseases or health problems do you think are related to salt intake? (*Name at least one*)

   high blood pressure, goitre

5. Are you aware of any major health problems or diseases that are related to too much fat intake?

Yes	☒
No	☐
Not sure	☐

If yes, what diseases or health problems do you think are related to fat intake? (*Name at least one*)

heart disease, obesity

6. Do you think the under listed foods help to reduce the chances of getting certain kinds of cancer? (tick one box per food)

	Yes	No	Not sure
Eating more fibre or roughage	☒	☐	☐
Eating less sugar	☐	☒	☐
Eating less fat	☐	☒	☐
Eating less salt	☐	☒	☐
Eating more fruits and vegetables	☒	☐	☐
Eating less preservatives/ additives	☐	☒	☐

7. Do you think the under listed foods will help prevent heart disease? (*tick one box per food*)

	Yes	No	Not sure
Eating more fibre or roughage	☐	☒	☐
Eating less fat	☒	☐	☐
Eating less salt	☒	☐	☐
Eating more fruits and vegetables	☒	☐	☐
Eating less preservatives/ additives	☐	☒	☐

8. Have you heard of blood cholesterol?

Yes	☒
No	☐ *If No, continue with question 10.*

9. Which one of the under listed foods is more likely to raise people's blood cholesterol level? (*tick one*)

Vegetables ……..	☐
Fruits ……..	☐
Animal fats……..	☒
Plant oils……..	☐
Legumes ……..	☐
Not sure……..	☐

10. Have you heard of antioxidant vitamins?

Yes	☒
No	☐ If No, continue with section E

11. If YES to question 10, do you think these are antioxidant vitamins? (*tick one box per vitamin*)

	Yes	No	Not sure
Vitamin A	☒	☐	☐
B complex vitamins	☐	☒	☐
Vitamin C	☒	☐	☐
Vitamin E	☒	☐	☐
Vitamin K	☐	☒	☐

E. Experts recommend consuming foods with more vitamins and minerals. Food companies add them through a process called fortification (i.e. fortified foods).

1. Have you heard about, fortified food on the market?

   Yes ☒ No ☐ ….If No is your answer, proceed to Section F

2. Which of the under listed foods have nutrients added (fortified) in Uganda? (*tick one box per food*)

	Yes	No	Not sure
Vegetable oil	☒	☐	☐
Sugar	☒	☐	☐
Maize flour	☒	☐	☐
Wheat flour (engano)	☒	☐	☐
Currypowder	☐	☒	☐
Salt	☒	☐	☐
Millet flour	☐	☒	☐
Soda	☐	☒	☐

3. Which of the under listed foods has iodine mandatorily added in Uganda? (*tick one box per food*)

	Yes	No	Not sure
Bread	☐	☒	☐
Vegetable oil	☐	☒	☐
Powdered milk	☐	☒	☐
Table salt	☒	☐	☐
Wheat flour (engano)	☐	☒	☐

4. Which of the under listed foods has vitamin A mandatorily added in Uganda? (*tick one box per food*)

	Yes	No	Not sure
Bread	☐	☒	☐
Vegetable oil	☒	☐	☐
Powdered milk	☐	☒	☐
Table salt	☐	☒	☐
Wheat flour (engano)	☐	☒	☐

5. Which of these logos must appear on the label of packages of foods with added nutrients (fortified) in Uganda? (*tick one box per logo*)

	Yes	No	Not sure
	☐	☒	☐
	☐	☒	☐
	☒	☐	☐
	☐	☒	☐

F. Sources of Health and Nutrition Information: In this section, we are seeking for the sources of information you use.

1. Where do you get your information about nutrition? (*tick one box per source*)

Source	Yes	No
Schools	☐	☐
Peers/friends	☐	☐
Health personnel	☐	☐
Parents/Guardian	☐	☐
Radio/TV/ magazines/books	☐	☐
Internet	☐	☐
Other (specify)……	☐	☐
……..……	☐	☐

2. From the choices you have selected above, how would you rate them as sources of information? (tick whether the source is Very unreliable; Unreliable; Reliable; or Very reliable)

Source	Very unreliable	Unreliable	Reliable	Very reliable
Schools	☐	☐	☐	☐
Peers/friends	☐	☐	☐	☐
Health personnel	☐	☐	☐	☐
Radio/TV/ magazines/books	☐	☐	☐	☐
Parents/ guardians	☐	☐	☐	☐
Internet	☐	☐	☐	☐
Other (specify)…… ……..	☐	☐	☐	☐

G. Finally, we would like to ask you a few questions about yourself.

1. What is your gender?

   Male …….. ☐

   Female ……..…….. ☐

2. How old are you?

   Less than 18…….. ☐

   18 -24 …….. ☐

   25 -34 …….. ☐

   35 - 44 …….. ☐

   45 -54 …….. ☐

   55 - 64 …….. ☐

   65 - 74 …….. ☐

   Above 74 ……..……..…….…….. ☐

3. Indicate the number of children you have. (*Tick one*)

   None …….. ☐

   1 ……..…….. ☐

   2 ……..…….. ☐

   3 ……..…….. ☐

   4 ……..…….. ☐

   More than 4 ……..…….. ☐

4. Do you have any children under 18 years, living with you?

   Yes ……..…….. ☐

   No ……..…….. ☐

5. What is the highest level of education you have completed?

   Primary school ……..…….. ☐

   O level secondary school…….…….. ☐

   A level (High school)…….…….. ☐

   Technical or tertiary certificate …….…….…….. ☐

   Diploma …….. ☐

   Degree ……..…….. ☐

   Post-graduate degree …….……...….. ☐

6. Do you have any nutrition related qualification?

Yes …….☐

Please specify

No ……..☐

7. Are your currently a nutrition student?

Yes …….☐

Please specify the course

No ……..☐

8. If you have a partner, does he/she have any nutrition related qualification or student?

Yes ……☐

Please specify

No ……☐

9. If you have a partner, what is his/her job? Even if he/she is not working now, what is his/her usual job? (please be specific):

_____

10. Are you on a special diet?

Yes ……..☐

Please specify:

No……..……..☐

THE END

Thank you very much for your time. If there are any comments you would like to make about this questionnaire, please do so below, they would be very welcome.

APPENDIX C: ORGANIZATION CHARACTERISTICS, AWARENESS, AND RECOMMENDED SCHOOL FEEDING PRACTICES QUESTIONNAIRE

School Characteristics Questionnaire

Characteristics of the School

1. Location of the School (*Tick one*) Rural ……..……....Urban……..
2. Distance of school from Kampala …….. (km)
3. Population of the: Sub County ……Village ……(Skip if you don't know it)
4. What year was the school established: …….
5. Total number of teachers …… Qualified …… Non-Qualified ……
6. Total non-teaching staff ……..
7. Registered population of the students in 2016 as of Term II …….
8. How many classes do you have in the school? (*Tick one*)
   One ☐ two☐ three☐ four☐ five☐ six☐ seven☐
9. Total number of class rooms in school assigned to the above classes……

Please fill in the table below to indicate the school performance in terms of student dropout (%), promoted, and math and Science pass (C6 to D1).

NB: Provide numbers and total number of registered students where percentages are inquired.

Indicator	**Measure**	**Class**	**Performance 2016**			
			Term one		**Term two**	
			Total registered	Number	Total registered	Number
Student dropout rate	% of enrolled students who dropped out i.e. number students that dropout/ total registered	P1				
		P2				
		P3				
		P4				
		P5				
		P6				
		P7				
Student Math Achievement	% of students with C6 or more in math. i.e. Number of students with C6 or more/ Total students who sat term exams	P1				
		P2				
		P3				
		P4				
		P5				
		P6				
		P7				
Student Science Achievement	% of students with C6 or more in science. i.e. Number of students with C6 or more/ Total students who sat term exams	P1				
		P2				
		P3				
		P4				
		P5				
		P6				
		P7				
Passed Primary leaving Exam (PLE).	% of P7 students who passed PLE in 2015 of registered	DIV I	DIV II	DIV III	DIV IV	FAILED

Management and leadership

For the tables below, use the following ratings key and *tick* in the respective number cell.

Rating	**Meaning**
1 = Strongly Disagree	The indicator or activity is seldom or never found in the classrooms or in the school. It is not a day today norm.
2 = Disagree	The indicator or activity is found in some classes, and sometimes in the school. It is not regular or frequent – most classes do not demonstrate this. It is the exception, not the norm.
3 = Agree	The indicator is found in most classes and most times throughout the school. This is the norm in the school, not the exception.
4 = Strongly Agree	This indicator is found in all classes and throughout the school at all times.

School climate

Indicator	1	2	3	4
1. The school community (teachers, head teacher, parents, and students) shows respect for each other.				
2. Head teacher, teachers, and parents regularly express confidence in students' ability to succeed.				
3. The school acknowledges its own teachers' achievements through regular awards, displays announcements and activities				
4. The school acknowledges its own students' achievements through regular awards, displays announcements and activities				
5. Students and parents regard that the school is a caring place				
6. Teachers, parents and students are dedicated to general success of the school				
7. Head teacher and teachers talk to students outside of the class, demonstrating concern.				
8. School facilities and premises are clean and orderly.				
9. Head teacher, teachers and students adhere to rules on punctuality, attendance, and class timetables.				
10. Parents are dedicated to the school and the school activities				
11. Teachers are dedicated to the school, school activities and students.				

School Management practices

Indicator	1	2	3	4
12. The school has a written mission statement.				
13. The mission statement is shared and understood by students, parents, teachers, head teachers, and community members.				
14. The school has clear standards of academic success that are known by teachers, students, and parents.				
15. The school has clear rules and regulations that are shared and understood by teachers, head teacher, students, and parents.				
16. The rules and regulations are consistently and fairly applied to teachers and students.				
17. The Head teacher, teachers and School Management Committee (SMC) explain the school goals to parents and teachers.				
18. The SMC regularly does class visits				
19. Discipline procedures are routine and focus on students' behavior				
20. Discipline procedures for teachers are routine				
21. Classes start on time with both students and teachers present				

Professional development

Indicator	1	2	3	4
22. The school has a regular schedule for in-school teacher meetings, including grading and subject meetings.				
23. The school adheres to the meeting schedule.				
24. All teachers participate in professional development activities at least four times a year.				
25. The school has a regular schedule for cluster meetings.				
26. The school adheres to the cluster meeting schedule				
27. The teachers actively identify problems and issues, and share ideas				
28. All of the teachers are qualified.				
29. All teachers are upgrading or pursuing higher qualifications				
30. The teachers actively identify methodological issues from their colleagues.				
31. The teachers actively seek support from their colleagues.				

School Planning

Indicator	1	2	3	4
32. The school has a School Development Plan (SDP) with active participation of teachers, parents, students and the head teacher				
33. The school community is actively implementing the SDP.				
34. The school development committee/ Parents Teachers' Association (PTA) leadership regularly monitors implementation progress.				
35. The school development committee/ PTA reviews and updates the SDP each year.				
36. The SDP helps everyone in the school to focus on what is being done and to improve school teaching and learning.				
37. The SDP helps school members gain active support and commitment from the community.				

School Support for Parent Involvement.

Indicator	1	2	3	4
38. The school has a regular schedule of activities that involve parents				
39. The school complies with its schedule of activities that involve parents				
40. The school has a variety of activities for parents (parent-teacher school activities, school committee, school-community activities)				
41. The school (teachers/management/principals/staff) welcomes and encourages parental involvement				
42. The school has a system of regular communication with parents				
43. The school has a regular parent-teacher communication schedule				
44. The school has regularly scheduled parent-teacher consultation (i.e. Parents to ask questions about the school and students' performance)				

Involvement of Parents in the School activities.

Indicator	1	2	3	4
45. Parents are active members of the Parents –Teachers' Association (PTA)				
46. Parents and community provide money, materials and resources				
47. Parents help out in the school (cleaning, special events, maintenance)				
48. Community members help out in the school (cleaning, special events, maintenance)				
49. Parents help out in the classroom (general support, recess, other activities in class)				
50. Community members help out in the classroom (general support, recess, other activities in class)				
51. Parents facilitate (teach, speak) in the classrooms when asked.				
52. Community members facilitate (teach, speak) in the classrooms when asked.				
53. Parents make sure that their own children attend each day				
54. Parents monitor attendance, volunteers visit homes of absent students				
55. Parents encourage their children to do well in school				
56. Parents provide students with time and space for homework				
57. More than 20% of parents are involved in the school in some way.				

School Materials

Indicator	1	2	3	4
58. The school has enough textbooks for all students				
59. Textbooks and materials arrive in time for classes.				
60. Every teacher has a syllabus for every subject.				
61. Classrooms have enough writing materials				
62. Classrooms have enough reading materials				
63. The school receives requested assistance in school planning				
64. The school receives requested assistance in professional and staff development				
65. The school initiates/requests special needs assistance				
66. The school has enough teaching aids				
67. The school receives assistance in specialized services (special needs)				

Thank you for your time

Characteristics of the head teacher and awareness of nutrition guidelines

1. How long have you worked as a teacher? _____ years.
2. How long have you worked as a head teacher? _____ years.
3. Where do currently stay? Village ……, Sub County …… District ……..
4. The following statements ask for your awareness on the Uganda Guidelines on School Feeding and Nutrition Intervention Programme (The guidelines).
   4.1 I am aware of The Guidelines. (tick only one)
   ☐ YES ☐ NO (If no, thank you for your time)
   If yes, respond to the statements below using the following options (tick only one option per statement):
   1 = Not true, 2 = True, 3 = I don't know

Based on your understanding of the Guidelines, they…	Not true	True	Not aware
4.2 Address the general quality of life for schoolchildren?	☐	☐	☐
4.3 Provide guidance to implement a structured school system?	☐	☐	☐
4.4 Provide different nutrition information or advice than other guidelines you know?	☐	☐	☐
4.5 Provide composition and functions of the School Food committee	☐	☐	☐
4.6 Provide composition and functions of the Procurement Committee.	☐	☐	☐
4.7 Provide procedures of handling supplementary packed food by the school children.	☐	☐	☐
4.8 Provides foods items that can be prepared at school.	☐	☐	☐

5. In the following table, indicate any or all the sources of nutrition information and how frequently you use them (tick only one option per source):
   If never, indicate if you do not have access (leave blank if you have access).

Source	Never	Sometimes	Often	Always	Do not have access
Uganda Food and Nutrition Policy	☐	☐	☐	☐	☐
Uganda Nutrition Action Plan	☐	☐	☐	☐	☐
Uganda Guidelines for School Feeding and Nutrition Programme	☐	☐	☐	☐	☐
Internet	☐	☐	☐	☐	☐
Magazine articles	☐	☐	☐	☐	☐
Food Labels	☐	☐	☐	☐	☐

Thank you for your time

School Feeding and Nutrition Recommendations and Practices Questionnaire

In the table below there are questions concerning your School Feeding Practices and Nutrition Related Activities. For the following statements, tick if, 1: Not in place, 2: Under development, 3: Fully in place.
Activities under development are those that you are considering implementing in the next year, or those that you are implementing within this year, but have not started.

Practice	Not in Place	Under Development	Fully in place
1. Written School feeding policy/ guidelines			
2. School Food Committee (SFC)			
3. Cash contributions for school food by parents			
4. Food contributions for school food by parents			
5. Food Procurement and transportation Committee			
6. Procurement guidelines			
7. Contracted food suppliers of the school			
8. Well-kept School Feeding Register			
9. Accountability of School Food Finances			
10. Food accounts comply with local government act.			
11. Food storage area			
12. Food preservation area			
13. Regular fumigation of storage and preservation areas			
14. The First-in-first-out principle is used to issues foods items used in the kitchen			
15. Assigned SFC member to receive and issue food items in the store			
16. Clean food utensils			
17. Routine medical examination of kitchen staff			
18. Hand washing facilities			
19. Safe drinking water			
20. There are proper documents of receipt and issuance of food items in school store			
21. Rubbish pits for food waste disposal			
22. Adequate school toilets or latrines 30 meters away from the kitchen			
23. Kitchen area			
24. Employed Kitchen staff			
25. There are first-aid kits in the school kitchen			
26. Firefighting equipment			
27. Documents on potential sources of food contamination are displayed in the kitchen			
28. Regular Meals are provided at School			
29. The school has menus or dietary plans for the week			
30. Meals in the daily menu are comprised of a staple, fruit/vegetable, meat, and dairy			
31. Fruits and vegetables are always served during school meals			

Practice	Not in Place	Under Development	Fully in place
32. Fortified cereal food items are provided during school meals			
33. All students receive physical education. i.e. time for physical education is allocated in the school time table for all classes			
34. There is a teacher allocated for physical education of the students.			
35. There is time allocated for games and sports.			
36. The school is involved with child health intervention (immunization, deworming nutrient supplementation)			
37. Parents are involved with child health intervention (immunization, deworming nutrient supplementation) at school			
38. The school meals provide a third of the energy requirements of the children			
39. The school curriculum has nutrition education integrated			
40. Co-curricular activities have nutrition activities integrated			
41. The school has nutrition education books			
42. Teachers are trained in nutrition education			
43. Teachers integrate nutrition education in their subjects			
44. The school has a garden for nutrition education and educational demonstrations.			
45. All the school Food committee member are trained to provide nutrition education			
46. All The school board/ PTA leadership are trained to provide nutrition education			
47. All Parents are trained in nutrition education			
48. Students are allowed to carry packed food			
49. The school has guidelines for packed food			
50. Packed food is regularly inspected			
51. Food vending is allowed			
52. There are school regulations for food vending			
53. There is monitoring and evaluation strategy			
54. There are termly reports submitted to the district (DEO)			

Answer the following questions based on the foods you have and use at your school. First, tick if you do (1: yes) or do not (2: no) have the item or if you are 3: not sure.
If you answered yes to the foods, tick the number of days you provide these foods to the students (1-7).

Food item	**In the store**	**Days per week**						
	1. Yes 2. No 3. Not sure	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Example. Ffene is in the school store. Ffene is provided 3 days each week.	1			✓				
Maize meal								
Maize meal (fortified with vitamins and minerals)								
Finger millet								
Rice								
Bread								
Wheat flour meals bread, Chapati								
Fresh cassava								
Green cooking banana (matooke)								
Irish Potatoes								
Sweet potatoes (white)								
Sweet potatoes (yellow or orange)								
Yams								
Beans								
Ground nuts								
Simsim								
Peas								
Beef								
Poultry (chicken, duck etc.)								
Eggs								
Milk								
Fish								
Raw tomatoes								
Onions								
Cabbages								
Yellow bananas								
Water melon								
Carrots								
Oranges								
Sugar								
Honey								
Margarine (fortified with vitamins A & E)								

Thank you for your time

APPENDIX D: DESCRIPTIVE STATISTICS OF CHARACTERISTICS FOR SCHOOLS AND HEAD TEACHERS

Characteristics	Var. Type*	N	Range	Minimum	Maximum	Mean	Std. Error	SD
1. Distance of the school from Kampala (km)	C	205	94.00	2.00	96.00	22.72	1.18	16.95
2. Total number of teachers	C	205	219.00	3.00	222.00	14.93	1.16	16.58
3. Number of Qualified teachers	C	205	76.00	0.00	76.00	12.71	0.59	8.41
4. Number of Non-qualified teachers	C	205	19.00	0.00	19.00	1.36	0.16	2.33
5. Number of non-teaching staff	C	203	392.00	0.00	392.00	7.79	2.00	28.46
6. Existence of school (years)	C	197	115.00	0.00	115.00	35.24	2.13	29.95
7. Experience as teacher (years)	C	202	42.00	2.00	44.00	18.72	0.70	9.91
8. Experience as head teacher (years)	C	201	33.50	0.50	34.00	9.67	0.56	7.89
9. School climate	O/C	204	29.00	11.00	40.00	31.82	0.39	5.52
10. School management practices	O/C	204	30.00	10.00	40.00	31.96	0.43	6.12
11. Professional development	O/C	204	34.00	6.00	40.00	30.02	0.40	5.77
12. School planning	O/C	203	19.00	5.00	24.00	17.09	0.30	4.30
13. School support for parents' involvement	O/C	203	44.00	6.00	50.00	22.08	0.36	5.15
14. Involvement of parents	O/C	203	15.00	5.00	20.00	13.05	0.20	2.90
15. School materials	O/C	203	25.00	7.00	32.00	20.03	0.33	4.66
16. Awareness score of school feeding & Nutrition Intervention guidelines	O/C	205	6.00	0.00	6.00	1.94	0.16	2.23
17. Frequency of information use score	O/C	205	16.00	6.00	22.00	8.39	0.24	3.49
18. Access score	O/C	205	6.00	0.00	6.00	1.54	0.15	2.12
19. Number of registered students	C	203	1856.00	10.00	1866.00	394.40	20.77	295.97
20. Total nutrition knowledge score	C	205	63.00	6.00	69.00	49.86	0.77	11.07

*Variable type: Continuous (C), Ordinal (O).